VOLUME 11 NUMBER 10 OCTOBER 1985 **$2.95**

Creative Computing

THE #1 MAGAZINE OF COMPUTER APPLICATIONS AND SOFTWARE

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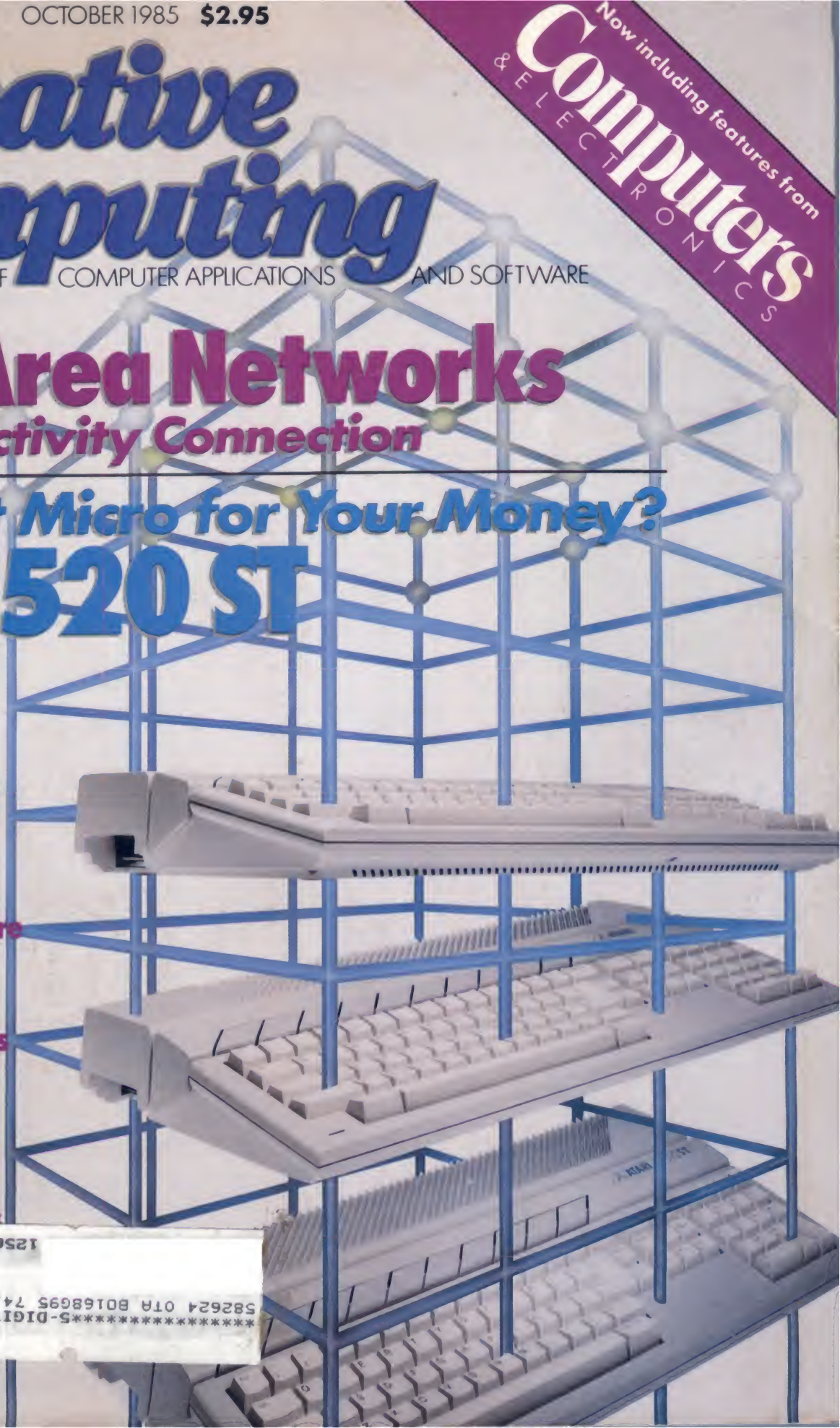

Introducing The Single Solution To Many Problems That Can Tie Up Your Personal Computer.

Transet 1000.™ The print buffer, communications buffer, port expander, printer sharer and I/O switcher. All in one.

Anyone with a personal computer and one or more peripherals has faced the all-too-familiar dilemma. You need your computer to do an important job. But you're forced to wait for the system to finish one job (printing, communicating, whatever) before you can go on to the next one. Or you need to stop what you're doing to switch cables when you want to use another peripheral.

Wait no more. Now Hayes introduces an innovative new device that lets you perform many jobs—at the same time—independent of your computer. Transet 1000. It works with a wide range of systems and configurations. And it allows you to continually expand your system as your needs grow.

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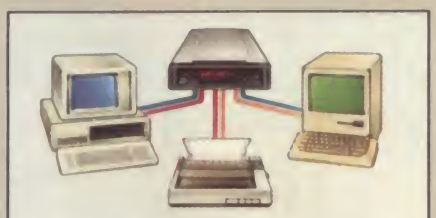
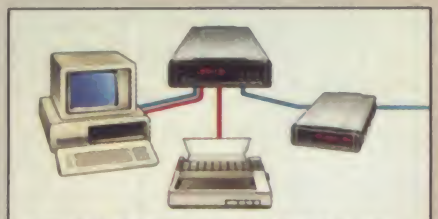


Two computers can share one printer with Transet 1000. Or, you can use Transet 1000 to let two computers communicate with each other.

In addition, Transet 1000 is a port expander and software-controlled I/O switcher. Now files can be easily directed and redirected to different peripherals, without physically changing cable connections.

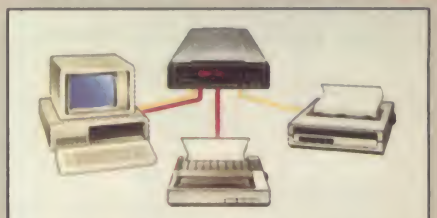
Transet 1000 contains a stand-alone microprocessor, and comes with 128K of memory. It operates with any RS-232C interface computer, and has optional accessory kits available for the IBM PC and PC XT, Macintosh and Apple IIc. Kits contain the necessary host cable, a user guide and menu-driven software that lets you graphically set up or customize port parameters and printing formats. Cables available for IBM PC AT, other computers and peripherals.



Even while printing, Transet 1000 acts as a communications buffer and 24-hour mailbox. And I/O switching lets you route information among peripherals, without switching cables.

Like all Hayes products, Transet 1000 combines sophisticated capabilities with easy operation. Just as Hayes set the standard in personal computer communications, now Hayes is taking the lead in computer task management.

Contact your authorized Hayes dealer to see how Transet 1000 can help you get a lot more productivity out of your computer system—without tying up your computer or you.



Transet 1000 allows printing on both a dot matrix printer and letter quality printer, while freeing your computer for other tasks.

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NOTICES

Re: Software Digest

Observant readers may have noticed a change in the name of our new software review section from Software Digest to Software Commentary. By way of explanation we can only say, "We goofed, and we're sorry." The name Software Digest was already taken.

Software Digest is an independent software testing company, which publishes the *Software Digest Ratings Newsletter*. The newsletter, which is actually a hefty magazine, contains no advertising and is published ten times a year. It is designed to provide reliable, comparative information on current software products for microcomputers.

Each issue includes a compatibility chart, an overview of the software category under discussion in the issue, comparison charts, a specifications and features chart, individual program reports, and benchmark test results. Write-ups of individual programs include specifications, screen photos, results of numerous benchmark tests, an evaluative "report card," and a list of strengths and limitations.

For more information, readers can write: Software Digest, One Winding Dr., Philadelphia, PA 19131, or call: (215) 878-9300.

7th National Educational Computing Conference

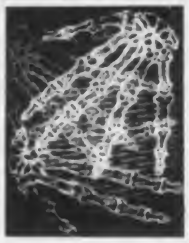
The 7th National Educational Computing Conference (NECC '86), hosted by the University of San Diego, will be held June 4-6, 1986.

Original papers are solicited from all academic disciplines and research areas in educational computing. Of particular interest are papers and projects prepared by students at the secondary, undergraduate, and graduate levels.

Authors should submit an original manuscript and four copies by November 1, 1985 to: NECC '86, University of San Diego, School of Education, Alcala Park, San Diego, CA 92110.

Corrections

In "Graphics Fireworks," the cover story of our July 1985 issue, one of the illustrative photographs was incorrectly credited. The design of the skeletal structure of a hand, featured at the bottom of pages 62-63, was created by Susan Arno of Elmhurst, IL.



In our August review of Paperback Software's *Executive Filer* (page 73), we listed the price as $69.95. The correct price is $49.95.

A line was omitted from the TRS-80 Model III program listing for "Legible Listings" (August, page 87). The final line:

```
250 LPRINTP$:LC=LC+1:RETURN
```

INPUT/OUTPUT

Bug in ROM Affects Sanyo Compatibility

Dear Editor:

Thank you for publishing your review of the Sanyo MBC-775 in the July issue of *Creative Computing*. I feel that Mr. Lockwood tried to be fair and had many complimentary things to say about our computer. However, I must take exception to his comments in regard to software compatibility with the IBM PC.

Mr. Lockwood stated that 50% of the programs he tried did not work on the MBC-775. I am completely baffled by this statement. Our computer runs practically all of the IBM software, including *Symphony, Framework, dBase III,* Lotus *1-2-3*, and, last but not least, *Flight Simulator*. In fact, the only software we have found not to run are programs that directly address the computer's hardware and depend upon the 4.77 MHz clock speed of the IBM. Most of the software that falls into this category are programs designed to defeat copy protection and operating systems other than MS-DOS.

It is true that the software bundled with the MBC-775 consists of the same packages that come with the MBC-555 series. While the company that made the software wrote special versions for the MBC-555, we are using the IBM PC versions for the portable computer. In fact, much of the software for the MBC-555 series (especially graphics software) will not run on the MBC-775, just as it will not run on the IBM PC.

I hope this clears up the issue of MBC-775 software compatibility. While Sanyo Business Systems Corporation never claimed IBM compatibility with the MBC-550 series, we certainly pride ourselves on a truly compatible portable color computer in the MBC-775.

Mark M. Zeiger
Research & Development Mgr.
Computer Division
Sanyo
51 Joseph St.
Moonachie, NJ 07074

The machine we reviewed was one of the first MBC-775s off the line. According to Sandy Waters, marketing manager for the Sanyo Computer Division, "a couple thousand" early models had a bug in the ROM. Hence, some software, notably our Flight Simulator, *did not run on the 775. Waters reports that this problem has been corrected and all the early models have been retrofitted with new ROM chips.*

As for the bundled software, the packages appeared to be recycled MBC-555 programs, but are indeed completely different. We stand corrected on the 555 to 775 translation.

Waters adds that the 43.1 lbs. is the shipping weight. The actual carrying weight is 36 pounds—still heavy, but better. Waters notes that the MBC-675, a $1799 IBM PC compatible transportable with 256K RAM, two floppy drives, and built-in 7" monochrome monitor, weighs 24 pounds.

Finally, an enhanced MBC-775, called the 775E, includes a heavy duty power supply, a 20Mb or 40Mb hard disk drive, and an external switch to operate the machine at 4.77 MHz (like the IBM PC) or the faster 8 MHz speed.—RL

INDUSTRY INSIDER

Betsy Staples

Shift in Emphasis at NCC

The National Computer Conference, long a bastion of big computing and terminal stuffiness, had a somewhat different look this summer. AFIPS, the sponsoring organization, faced with a decline in number of exhibitors and several consecutive years of slackened attendance (we first assumed slackened attendance in 1983 when AFIPS abruptly instituted a policy of refusing to reveal attendance figures), appears to have softened its hard line

trade-only approach to the show. Observers report that show organizers all but dumped free tickets on downtown Chicago and environs from low-flying aircraft.

Those end users who did attend were rewarded with exhibits featuring more than the usual number of personal computers and compatible peripherals. Despite the fact that Apple, DEC, and Wang Labs all failed to exhibit, a situation of which much was made in the general press, many companies were showing significant new products.

Among the most exciting of the announcements for personal computers users was the Sharp PC-7000, a compact (19 lbs.) transportable MS-DOS computer with a very small footprint. It features a 25-line by 80-character LCD, backlighted with an electroluminescent panel; 320K of memory, and two 5.25" disk drives. Priced at less than $2000, the machine should have a rosy future in the clone market.

Panasonic also unveiled a transportable—the Executive Partner. Quite a bit heavier (28 lbs.) than the Sharp machine, this one features a compact plasma display.

On the software side, Addison-Wesley was demonstrating the long-awaited microcomputer version of Tex, Donald Knuth's word processor designed especially for scientific and mathematical work. *Micro Tex*, as the package is called, can also be used with the original mainframe version.

Softstyle of Honolulu, HI, was showing *Decisionmap*, a graphics based decision modeling software package for the Macintosh that allows the user to explore the effects of giving different weights to decision factors. He can create a detailed "map" diagram of these factors, rank alternatives for each, and instantly see the results on the screen. Softstyle also announced a product that allows color printing using the Macintosh and an NEC color printer.

Apple, AST May Join Forces

In what may be the first evidence of its recently announced commitment to open architecture for the Macintosh, Apple Computer is reported to be discussing with AST Research of Irvine, CA, an arrangement whereby the computer company would resell an as-yet-unannounced file server and backup tape drives for the Mac. According to the Computer Industry Daily, a sister Ziff-Davis publication, the talks involve a 20Mb tape backup system using PC1000 tape cartridges. The file server offers 80Mb of storage and a 60Mb tape backup.

An AST spokesman told CID that if no agreement is reached with Apple, AST will market both products on its own.

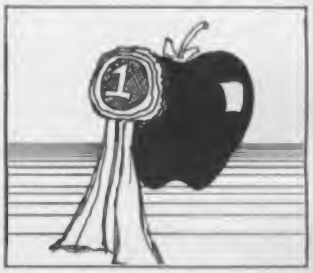
AST Research, a leading supplier of add-on boards for the IBM PC, has recently begun to broaden its marketing focus with the introduction of add-on I/O boards, a disk-tape subsystem for the Apple IIe, and a semiconductor memory add-on for the ill-fated Lisa/Macintosh XL. Could it be that AST has glimpsed the handwriting on the wall and it is not all blue?

Apple is Top Choice

According to Future Computing, a market research firm specializing in the personal computer industry, the future is multicolored for most of the consumers planning to buy a computer for home use in the next year.

Among prospective buyers, 32% of those surveyed indicated that they plan to buy an Apple model, and 26%, an IBM model. This is a dramatic difference from the brand share standings in the current installed base; only 16% of current personal computer owners have Apples, and only 8% have IBMs.

As for other brands, Commodore computers are currently owned by 30% of the consumers surveyed, but only 24% of prospective buyers indicated plans to purchase Commodores next year. Tandy and Atari models are owned by 10% of those surveyed. Three percent of prospective buyers said they planned to purchase a Tandy, and 2%, an Atari.



In interpreting the survey, Future Computing says that "Consumers are shifting away from the low-end game machines to the higher priced, higher capability personal computers."

Random Bits

Ashton-Tate, maker of the *dBase* family of database software, has announced its intention to purchase Multimate International, maker of the popular *Multimate* word processor for a whopping $19 million. Ashton-Tate also announced an increase of 114% in net revenues for the first quarter of fiscal 1986 . . . **ACT**, the U.K. manufacturer of the Apricot line of microcomputers has announced an increase of 129% in annual pretax profits over last year.

Alphacom of Sunnyvale, CA, a manufacturer of low-end printers, has run out of ribbon and is attempting to reach a settlement with Bank of America, a secured creditor.

Of the 72,651 patents issued by the United States in 1984, 40% were granted to residents of other countries. Sixteen percent were granted to Japanese citizens.

Hayes Microcomputer Products has voluntarily withdrawn its action against General DataComm in which it alleged that a General DataComm ad contained false statements comparing a General DataComm modem with the competitive Hayes model . . . Apple Computer has won a high court judgment against Pineapple Computer Products of Hong Kong, a distributor charged with selling Apple look-alikes. ■

$699 Computer Breakthrough

IBM compatible computer with 128K memory and two disk drives is more than a bargain.

The Visual Commuter sells for only $699. The IBM monochrome monitor is optional.

A *It carries like a briefcase.*

B *With LCD lid open.*

It's a new concept. And if my hunches are correct, the new Visual Commuter will take years for others to copy.

By Joseph Sugarman, President

First, it is a tremendous bargain. At $699 nothing even comes near. Secondly, it's powerful. You get 128K memory that's expandable to 512K. And finally, it's totally IBM compatible. It will even run the Flight Simulator program and Lotus Symphony™ But there's more.

The unit can be used as a stand-alone office computer as shown above or it can be packed up and used as a portable—but without all the weight. There's an optional 16-line x 80 character LCD display that pops up to replace the heavy CRT monitor. Unlike the smaller portable computer keyboards, the Commuter keyboard is a full-size replica of the IBM with its ten function keys and numeric key pad. And the Commuter uses 5¼" disks so you have full access to all the popular IBM software.

It's lighter (only 18 lbs), flatter (only 3½" thick) and carries like a briefcase. In short, the Visual Commuter is a combination of all the good features of a portable computer (size, weight, portability), all the good features of a traditional desktop computer (full-size keyboard, 5¼" disks, full power) and none of the disadvantages of either.

USE IBM PROGRAMS

Even if you have another computer but miss some of the IBM programs, for only $699 and an IBM compatible monitor, you've got a complete MS/DOS system.

It was also made modular so you can select just those components that you need for your particular application. For example, you may not need the 16 line x 80 column LCD display which adds 2 lbs to the unit's weight (a blank lid comes with the unit). Or you may not need a monitor because your other computer may already have one. But you may want more power—256K or 512K—so you order just what you need.

For all you technical people, listen to these specs. There's a 16-bit 8088 processor, 128K memory with parity, parallel printer port, serial ASYNC RS 232C port, Din connector RF modulator or composite video output for TV and composite video input monitors, RGB/direct drive output for high resolution monochrome or color monitors, IBM compatible color graphic support, support logic for 80x25 or 40x25 character display and LCD display, connector to IBM expansion unit, disk controller supporting two 5¼" disk drives, ANSI standard ROM-based terminal emulation, and ROM-based extended diagnostics. The dual disk drives are double sided-double density (360 Kbytes). The Commuter runs at the same clock speed as the IBM PC (4.77 MHz) but because of its new design, it runs between 8 to 10 percent faster.

ATTRACTIVE CASE

There's an attractive carrying case made by American Tourister that holds your software, your power cord, your documents and even our optional 1200 baud modem. The compatible Maxwell modem lets you communicate with other data banks. Made by the world's largest modem manufacturer, Racal-Vadic, it is normally a $500 value but our price is only $249 which includes a complete communications software package. There's also a toll free, on-line warranty service and a customer hotline to answer any of your technical questions.

You may have recently heard of Visual Technology Incorporated. They are innovators in the design and manufacture of smart alphanumeric terminals and some of the finest graphic terminals in the country.

The Visual Commuter was scheduled to sell for over $2500 with the LCD display. And even at that price, when compared to the IBM system, it was a good value. But JS&A and Visual (in a joint venture with SGD Holding Corp.) saw the opportunity of having just one customer. Together, by selling directly to you, we've eliminated the distributors, dealers and all the sales, administration and advertising costs and have passed the savings on to you. But there are a few catches.

JUST A FEW THOUGH

Once we install the memory, you'll have to send the unit back to us to add more memory. So we ask that you estimate, in advance, the maximum power that you'll require for your needs. 128K memory is plenty for most applications but if you want to run Lotus Symphony, you'll need all 512K. Secondly, we ask that you pay by check or money order. COD's and credit cards cost us too much to be able to provide this kind of value. And finally, we ask that you act quickly. Although we have most of the product in stock right now, there's always the chance that we'll run out.

The Visual Commuter measures only 3½ x 15½ x 18" wide and comes complete with power cord (it only operates on standard AC current), the operating system (Micro-Soft's MS/DOS ver. 2.1) complete with basic and utilities, two beautifully written manuals, lid (without LCD display) and a limited 90-day warranty. There are service centers throughout the United States set up to service the unit in addition to the service-by-mail facility at Visual's home office near Boston.

I urge you to give the Visual Commuter a test. Order one from JS&A and use it for 30 days without risk. Plug in your IBM monitor and load any of the IBM software you currently have. See how the large keyboard matches the IBM perfectly and how its handle makes a perfect hand rest while typing or a comfortable handle for carrying the unit. See how convenient the unit is to take home or bring with you on a trip with its fold open LCD monitor. If you don't feel that the Visual Commuter is more than you expected, pack it up and ship it back within 30 days for a prompt and courteous refund including postage. You can't lose.

PERSONALLY USED

I have personally used the Visual Commuter. I have taken it with me on trips, set it up as a stand alone by plugging in my IBM monitor. I have run everything from Symphony™ to Wordstar®—from 1-2-3® to the Flight Simulator program. I strongly recommend the system. To order, send your check or money order to the address below listing the items and order numbers (shown in parentheses). Thanks to the latest in technology and a direct-to-consumer marketing program, this system can be yours at a tremendous value. Order your Visual Commuter at no obligation, today.

Visual Commuter with 2 Disk Drives and 128K Memory (6105)	**$699**
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Carrying Case (6113)	**99**

Add $25 postage and handling per system.

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RECREATIONAL COMPUTING

More on N-Persistence / Michael W. Ecker

In this column last time, we looked at a number that I pulled out of thin air and which had the property of being 16-persistent: That is, the number times any one of 1, 2, 3, . . . , 15, 16 always produced an answer that contained at least one of each digit. Where did I get this number from? Does it have any special significance, or is it just something contrived, found by trial-and-error and lacking in richness?

It would be unreasonable to expect me to foist a contrivance on you, right? So, you can believe that there is some significance to such numbers. Even if you have seen many math recreations, I doubt that you will find this concept in any text. That is because I myself created the concept of n-persistent number a couple of years ago. Moreover, I showed the interesting connection of this concept to one which has been around a while longer. And that is the topic of this month's investigation.

Not to keep you in the dark any longer, the number 5882352941176470 comes from the repetend—or smallest repeating block—in the division of 1 by 17, as 1/17 = .0588235294117647 0588235294117647 058823529411 7647 . . . ad infinitum, where the repetend has a length of 16—meaning the digits repeat precisely every 16 digits. (First 16-persistence and now a length of 16; interesting, eh?) The only difference is that I put the leading zero at the tail of our integer, since we don't count leading zeros in whole numbers, as in 34, not 034. (If you prefer, you can note that 10/17 would produce our 16-persistent number with the zero intact.) Note that I'm *not* saying that this is the *only* way to produce any n-persistence. I do maintain, however, that it is certainly the most elegant.

So now I have replaced one mystery with a bigger one. What does this have to do with producing n-persistent numbers in general, and why does this work? It would be a lot easier if I could work with smaller numbers just to illustrate the point. Momentarily ignore the question of n-persistence and consider the repetend corresponding to 1/7. Division produces 1/7 = .142857 142857 142857 . . . ad infinitum. A more familiar example to readers would be 1/3 = .3 3 3 . . . ad infinitum, or even 1/5 = .2 0 0 0 . . . etc., where I have added the zeros for emphasis.

Dr. Michael W. Ecker is Associate Professor of Mathematics and Computer Science at the University of Scranton in Scranton, PA.

Listing 1.

```
10 CLS: PRINT "Calculate Repeating Decimals": PRINT
20 INPUT "Numerator";N
30 INPUT "Denominator";D
40 IF N>=D THEN PRINT "Please use Num < Denom": GOTO 20
50 PRINT: PRINT N;"/";D;" =": PRINT: PRINT ".";
60 N=(N-D*A)*10: ' New numerator for next stage in division
70 A=INT(N/D): ' This is a digit obtained in the repetend
80 PRINT A;
90 COUNT=COUNT+1: IF COUNT<D-1 THEN 60 ELSE PRINT "etc."
100 PRINT: INPUT "Another";X$: IF X$="Y" THEN RUN 20 ELSE END
```

Repeating Decimals sample run.

```
Calculate Repeating Decimals

Numerator? 1
Denominator? 7

 1 / 7  =

. 1  4  2  8  5  7 etc.

Another? Y
Numerator? 1
Denominator? 17

 1 / 17  =

. 0  5  8  8  2  3  5  2  9  4  1  1  7  6  4  7 etc.

Another?
```

Realize that no repetend in the division of 1 by p can contain more than p-1 digits in the repetend. In the case of 7, we are saying that the repetend could not have had more than six digits; in the case of 5, at most four digits. Why is this? Simple. When you divide 1 by p, once the digits start repeating, there are only p possible remainders in the actual division, namely 0, 1, 2, . . . up to p–1. If the remainder is ever 0, as soon happens with the division of 1 by 5, then the division terminates and we get a terminating decimal, or we can say the repetend is 0. Otherwise, we only get p–1 remainders.

Within p-1 steps, any remainder must repeat, which then makes the digits of the decimal quotient repeat within a block of at most p-1 digits. In the limited space available here it is difficult to explain this. I explained this phenomenon—along with some other neat properties—in a lengthier discovery and expository article "The Alluring Lore of Cyclic Numbers" several years ago in the *College Mathematics Journal*. Readers who don't wish to hunt this down in a math library can send me a self-addressed, stamped envelope and a dollar (to cover photocopy costs), and I'll send a reprint.

Well, it turns out that whenever the prime number p has the property that 1/p has a repetend with the largest possible length, namely p–1, the resulting repetend always has an interesting property. That property is that if you take any of 1, 2, . . . , p–1, and multiply by the repetend, you get the same digits in the answer but in a different order.

Consider for example the number 142857, the repetend of 1/7. We have the following: 1x142857 = 142857, 2x142857 = 285714, 3x142857 = 428571, 4x142857 = 571428, 5x142857 = 714258, 6x142857 = 857142, and lastly, 7x142857 = 999999. There is a delightful trick associated with this, but alas, we have no space this month. These last multiplications should also remind you of last month's program in which our special number was 16-persistent, but not 17-persistent, since we got a whole lot of nines when we multiplied by 17. Here, 7 plays the role of 17. As for the nines, it has to do with the mathematical fact that .9 9 9 9 . . . ad infinitum is exactly equal to 1—but that in itself is another story.

Whenever the reciprocal (1/p) of a prime p has a repetend with a full-period, we call that prime a full-period prime. The first p-1 multiples of that repetend always are cyclic permutations of one another (barring any missing leading ze-

The Self-Reference Challenge

```
1 FOR A=1 TO 9: NEXT: A$(1)=" FOR A=1 TO 9: NEXT: A$(1)="
2 A$(9)=MID$(A$(1),15,5): A$(2)=" A$(9)=MID$(A$(1),15,5): A$(2)="
3 FOR A=1 TO 9: A$(3)= " FOR A=1 TO 9: A$(3)="
4 PRINT CHR$(A+48);: A$(4)=" PRINT CHR$(A+48);: A$(4)="
5 B$=CHR$(34): A$(5)=" B$=CHR$(34): A$(5)="
6 PRINT A$(A);: A$(6)=" PRINT A$(A);: A$(6)="
7 IF A=9 THEN 9 ELSE A$(7)=" IF A=9 THEN 9 ELSE A$(7)="
8 PRINT B$;A$(A);B$: A$(8)=" PRINT B$;A$(A);B$: A$(8)="
9 NEXT
```

A program that lists precisely itself, submitted by Jerold A. Stahly of Lancaster, PA. Not only does the program meet the condition of the problem better (see June 1985 issue), but it seems to be a bit shorter to boot. Note the use of the CHR$ function to get around the problem of "line numbers" in the run not beginning flush left—they do in this program.

ros). For that reason, such primes are also called cyclic primes. To apply this, then, to n-persistence, all you need to do is find a cyclic prime p which is greater than n and 10, take 1/p, and the resulting repetend will be a number which is cyclic. It turns out that there is an almost uniform distribution of digits in the repetend, assuring that each digit appears at least once. Since the repetend is p–1–persistent, and p–1 is at least n, it is, *a fortiori*, n-persistent as well.

A program to find such repetends can be demanding, so I will solicit your improvements in a moment. The program here simply simulates the division of any numerator by any denominator. It is up to you to restrict yourself to using prime denominators p; the numerator need not be 1. The program prints out the first p–1 digits of the quotient. These may be manually examined for smaller repeating blocks. If you find a smaller repeating block, then the number p is not a full-period or cyclic prime. If none is found, you have one.

As a final note, I must confess to one gap: As of 1985, it is conjectured, but still not proven, that the number of cyclic primes is infinite. We all know that the number of primes (cyclic or not) is infinite, and there is strong evidence that the same is true of full-period ones, but there is no proof yet. When that is done, we will know that for every n, there exists an n-persistent number which we can generate in this manner. If it makes you feel any better though, other proofs exist which do not rely on cyclic primes. However, these lack the elegance—and fun—of this exploration.

This column is open to reader suggestions, questions of a relevant nature, improvements, comments, etc. If you would like an acknowledgment or reply, be sure to enclose a self-addressed, stamped envelope. Write me at 129 Carol Dr., Clarks Summit, PA 18411.

Until next month, happy recreational computing. ■

TELETALK

Bulletin: Telex not dead!/**Corey Sandler**

Remember Telex? Sure you do—it was that clanky, cranky old teletype machine in the shipping department that would rumble to life every once in a while and laboriously churn out a few pages of orders from Knockemstiff (Ohio), Bustard Head (Australia), Flin Flon (Manitoba), or other such outposts of civilization.

Truth was you could grow a beard watching a Telex machine as it pecked its capital letters at 50 baud, a rate that can be pleasing only to a certified dyslexic. That's not a typographical error: 50 baud, as in one twenty-fourth the speed of your basic 1200 baud modem or one forty-eighth as fast as the 2400 baud models currently filling the shelves. That's 50 baud, as in about 2 minutes to print this column up to this point.

But the importance of Telex was that it served as a 24-hour link between nearly anywhere and anyplace, bridging continents and time zones. In the days before computers and telecommunications were envisioned, Telex was the cat's pajamas.

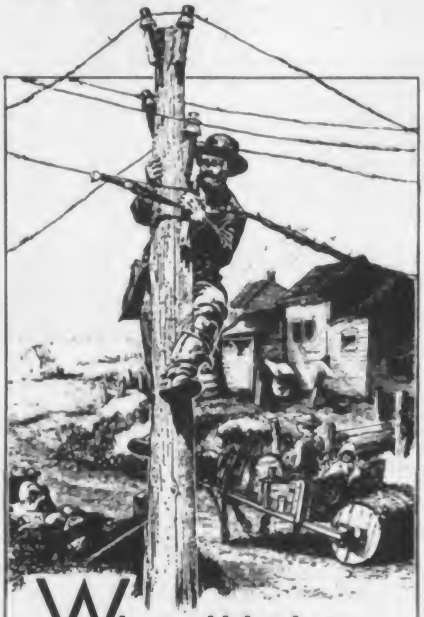
But why concern ourselves with Telex today, now that we have worldwide telephone service, with such additional helpful offerings as electronic mail and point-to-point telecommunications from desktop microcomputer to microcomputer? Well, the truth of the matter is that telephone service is not always available, and time zone differences may make it all but impossible to make direct connection. And electronic mail and point-to-point telecommunications do not yet cross all international borders. And finally, there is not yet a microcomputer on every desktop, and not all of those that are in place are tied into telephone lines.

The fact is that the only fast way to reach Knockemstiff, Bustard Head, or Flin Flon may well be via a dusty old Telex in the back room of the post office/general store.

And so, old clanky, cranky Telex is not dead. It is chugging along at its boring yet reliable speed in the United States, and in some parts of the world, especially in lesser developed nations, Telex is still growing nicely.

A Telex True Believer

"I don't think Telex is dying," says Seth Blumenfeld, president of MCI International. "I think it's certainly a mature service as far as the U.S. market is concerned. But worldwide, the best guess is that Telex is still growing at a low double-digit rate."



Why would developing countries want to install the Telex system?

Blumenfeld should know, since his company has just spent $100 million upgrading its facilities, including its Western Union International subsidiary. WUI, its Telex arm purchased in 1982, is not to be confused with Western Union Co.'s Telex system, with which it competes.

"I'd like to think we don't have our heads in the sand," he continued. "The U.S. market is flattening out, and we expect negative growth soon."

That flattening market is still a fat one, with worldwide revenues estimated at about $550 million and U.S. receipts of $150 million, with the largest market stream for Telex between Western Europe and the U.S. In the U.S. about half a dozen carriers—MCI, Western Union, ITT, and others—split the domestic market; overseas most European countries and many other countries have government monopolies called Postal Telegraph and Telephone companies running the show.

"Telex is flourishing in lesser developed countries, in places like Latin America, the Far East, and the Middle East," Blumenfeld said. "In some countries they have thousands of customers on waiting lists."

Why would developing countries want to install the pokey Telex system instead of going all the way and putting in state-of-the-art highspeed telecommunications networks?

"You've got to walk before you run. You wouldn't go from a bicycle to a supersonic jet. Telex is still an excellent technology and an excellent service," he said.

Blumenfeld also does not expect the U.S. market suddenly to dry up and go away. Many thousands of major accounts require the Telex machines to maintain contact with overseas points. There are also more than 100,000 smaller Telex accounts in the U.S., many of which are used for domestic point-to-point communication.

"The small Telex subscriber is not necessarily inclined to go out and purchase more costly equipment like personal computers," Blumenfeld said. "They don't have the volume."

But, you may ask, what about all of this talk about the electronic office, with a PC on every desk from the CEO to the cleaning woman?

"We've heard all the noise about the office of the future," Blumenfeld told me. "I think it's going to happen, but not as quickly as many of us in industry would have believed. I believe in the office of future, but I'm not exactly sure how we get there."

The Slow Boat from London

But speaking of getting there, it is the existing international Telex network that provides a desktop link from personal computers to the rest of the world.

I received an important letter from a British publisher recently—a letter I had been awaiting for a long time. In fact, I had all but given them up for dead, since it had been three months since we last had exchanged letters. But finally, a bedraggled package landed on my doorstep, dated 90 days earlier. I've decided it travelled through all of the remnants of the British Empire en route, with a four-week stopover in Mandalay.

So I decided to reply more directly. That's a lot easier said than done. Have you ever figured out the business overlap

PRINTER BARGAIN

We guarantee that you'll never find a bargain as sensational as the letter-quality daisy wheel printer you see in this advertisement.

We covered up the name of the printer so as not to embarrass the manufacturer.

I realize that what you are about to read may seem incredible. I can understand. But occasionally there are indeed bargains and opportunities that only come once in a lifetime. I'm convinced that this is one of them.

By Joseph Sugarman, President

The letter-quality printer you see above has a suggested retail price of $1795. It prints bi-directionally at 40 characters per second using a daisy wheel print element, comes with a parallel interface and prints a 13.6 inch line.

A similar printer might be found at some discount computer dealers for as low as $1000. And at that price it is indeed a bargain.

AUTOMATIC FEATURES

If we'd offer it to you at $499—a unit that we could be selling for $1795 and that would be a bargain at $1000—you'd probably think that there was a catch. But guess again. As unusual a bargain as this may appear, and despite all its quality features, this printer can be yours for the incredible low price of only $499—below wholesale, below dealer cost and without question, the lowest priced high-speed letter-quality printer sold today.

JS&A bought out an entire warehouse full of these printers, promised that we would not display the name on the unit, in our photo, mention the name in our ad nor reveal the name over the phone to avoid embarrassing the manufacturer or his dealers.

I'm so convinced that this is one of the greatest values I've ever offered, I am making a bet and a commitment. First, the commitment. I'm giving you 30 days to test it out. If it's not the best printer value in the country, return it for a full refund including your $25 postage.

Finally, I'll bet that you'll immediately recognize the name of the billion dollar company whose name is on the product or you don't deserve to own a computer. The company is a successful computer company whose products you may even now own. They'll back the product with service through its 90-day limited warranty and for years to come with hundreds of national factory service centers throughout the United States.

EXCEPTIONAL VALUE

The printer is not an outdated model with old technology but a brand new unit with the latest electronics and the most advanced technology. For example, there's an automatic print pressure control which automatically varies the printing pressure according to the shape of the character. This single feature produces an incredibly clean impression while prolonging the life of the daisy wheel. But there's more.

An aluminum diecast integral-constructed frame gives the printer a solid home for its advanced electronics. And with a weight of 30 pounds, you know there's built-in commercial-quality construction. The controls include: 'line feed' which advances the carriage by one line, 'page advance' which advances the document to the next page when using continuous form paper and a 'set page' button that tells the printer where the start of the form is located. A lighted condition panel tells you the printer status with red and green LEDs. You can use single sheets or continuous form fan-fold paper and with the 'paper out sensor' the printer detects the last sheet of the fan fold paper and automatically stops. And the printer has a 2K buffer memory.

There are also features that give you enormous printing flexibility. You can underscore words, double print each character which creates a bold look or you can use shadow print which moves the print head 1/120th of an inch between strikes. With the proper daisy wheel you can also set the printer for proportional printing which gives your documents a professional—almost printed look.

SELF-TEST MODE

There's a self-test mode which lets you print out all the characters on your daisy wheel continually until you stop. And the system uses standard Diablo daisy wheels and ribbons which you can get from JS&A or any computer store.

With the Pica pitch, you can print up to 136 columns and with the Elite pitch, up to 163. The 15.5" carriage will take a print area of 13.6 inches. It measures 6 x 16 x 24", comes with a 10-pitch daisy wheel, one ribbon and complete instructions. The unit has provisions for a tractor feed and a sheet feeder which can be purchased locally or at a discount from JS&A.

You can select either 10, 12 or 15 for the print pitch or even use the 10-pitch daisy wheel supplied with the unit at the 12-pitch setting for large and tight letter spacing. There are dip switches which let you customize each printer to any computer with a parallel printer interface. Setting recommendations are supplied for IBM, Apple and other popular computers.

What happened? How can JS&A obtain and then sell these printers—products that are brand new with the latest state-of-the-art technology and from a major manufacturer at a price that at first is hard to believe? Quite frankly, it wasn't easy.

With our low overhead we can efficiently sell these units in tremendous quantities without the high markups that many stores must have to make a profit. And we can do this on a mass-market national scale. Since many manufacturers know this and know that we could quickly move tremendous amounts of merchandise without upsetting many of the retailers (because we keep the name of the manufacturer confidential) they are willing to let us buy their product direct, often at foreign, export prices.

We'll be happy to supply companies with several printers for their computer departments to upgrade their printing speed and quality. There is no limit to the number you can order although we only have a few thousand available so we reserve the right to return your order should we run out.

ACT QUICKLY

There are bargains available that are indeed too good to be true and often end up to be much less than you expected. But here's an example that is not only too good to be true but that we guarantee you'll find better than you expected. Order one at no obligation, today.

Simply send your check or money order using the order numbers shown in parentheses (IL residents add 7% sales tax) plus $25 for postage and handling for each printer ordered. Credit card buyers call toll-free number below. Send your order to: JS&A Special Printer Bargain Offer at the address below.

Printer (6087)	**$499**
Tractor Feed (6084)	**189**
Sheet Feeder (6088)	**239**
3-Pack Ribbons (6089)	**15**
Daisy Wheels: (List supplied with unit)	
Cables/Interfaces (includes everything you need to connect to your computer:	
IBM & Compatibles (25 pin) (6076)	**39**
Apple II + /e (6099)	**69**
Apple IIc (7011)	**69**
Commodore VIC-20 C-64 &C-128 (7002)	**69**
Atari 400/600/600XL/800/800XL (7003)	**69**
Visual 1050 (7004)	**39**
All Other Computers with Standard Parallel Printer Port (36 Pin) (7009)	**39**

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between the U.S. and London? When it is 9:00 a.m. in New York, it is 3:00 p.m. in England, giving you two hours to track someone down. (You can also hope they don't try to call you at 9:00 a.m. London time—that's 3:00 in the morning in New York, midnight in California.) It is worse in a connection from the West Coast: when you arrive at work at 9:00 a.m. in San Francisco, the British work day has already been over for an hour or so.

The solution I chose was good old Telex, using the services of my trusty PC and MCI Mail. I sent a Telex one afternoon and received my reply when I signed on to MCI the next morning.

All you need is a computer, a modem tied into a phone line, a basic telecommunications program, and access to one of the services.

MCI Mail, which has been the most aggressive participant in the newly emerging electronic mail network industry, offers outgoing and incoming Telex service from around the world and across the United States. To use the service, an MCI registrant merely enters a Telex code as the address in the standard letter format for that service.

Telex subscribers worldwide, whether or not they are registered for MCI Mail, can communicate with you by directing their messages to MCI's incoming Telex number. The dispatches are placed in your incoming electronic mailbox.

MCI's Telex rates are based on a 400-character "mini-ounce." Some countries have three-ounce minimums. For a full listing of area codes and prices from Abu Dhabi to Zimbabwe, together with instructions on use of MCI Mail for Telex messages, contact MCI at 1900 M St., N.W., Washington, DC 20036, or send them an electronic message at MCI Customer Service. MCI will also contact as many as ten of your regular Telex correspondents for free and provide them with instructions on how to reach you in the U.S.

Western Union's EasyLink service is close to MCI Mail in range of services, including electronic mail, Telex, telegrams, cablegrams, and a business, news, and sports database on-line. Western Union operates one of the largest Telex systems in the world—its circuits are used by most of its competitors at one point or another in communication and the company provides its subscribers with the phone book-like Western Union Telex Directory. Contact Western Union/Easylink at One Lake St., Upper Saddle River, NJ 07458.

ITT's Worldcom Telex includes access to real time "interactive telex." In effect, this allows you to use ITT's facilities for standard on-line communications. Ordinary store and forward Telex is available, as is an electronic mailbox for incoming messages. For information contact ITT World Communications, Sales Department, 100 Plaza Dr., Secaucus, NJ 07096.

RCA Global Communications offers the same range of services, and the company can be reached at 201 Centennial Ave., Box KC-8, Piscataway, NJ 08854.

Almost all of these services will work well with standard PC telecommunications software, and at standard 300 and 1200 baud communication rates, with 2400 baud coming on line here and there. You can, in most instances, compose your message directly on screen and then send it, or you can prepare it earlier with a standard word processor and then upload it once you are signed onto the service. EasyLink is offering a specialized communications package called Easy Link Mail Manager. This PC software includes a word processor, telecommunications link, and automatic sign-on procedure for that service. MCI has just introduced a new software product called Comdesk specialized for Telex purposes.

The Togetherness of the Long-Distance Runner

But the tides of change don't merely run from the highspeed computer to the Telex machine. Now the world traveler need not leave home without his stockbroker or his daily newspaper.

MCI International introduced a few months back a link from the 2.5 million Telex machines around the world to an online stock transaction and information service. The new product, called Insight, allows worldwide Telex subscribers to obtain stock market quotations, interest rates, and other information, and to execute trades through a discount brokerage firm. Also included in the service are AP and UPI news tickers as well as specialized financial information including commodities trades, livestock prices, interest rate information, gold and metal prices.

According to MCI's Blumenfeld, principal users of the system will include foreign individuals and companies engaging in transactions on American and other major international foreign financial markets and exchanges, as well as traveling business people. U.S. Telex subscribers can also sign on directly to

the system. There will be no charge for retrieval of the information in the database, with users paying only ordinary Telex communications charges. MCI would make its profit from those charges. Typical international rates are about $1 per minute, he said.

The Insight package, however, will be available through any Telex provider. And, travelling Americans can make use of the Telex booths that are fairly common in European airports and other public locations.

RCA Globcom has a system called FYI News Service that provides news, financial information, sports, weather, and other data for overseas subscribers all for the cost of a Telex link to the U.S.

The Direct Link to Come

It should be obvious to the PC user that even with the advances in Telex, the faster and simpler route would be the extension of electronic mail service across international borders. The U.S. providers, MCI Mail among them, are trying to do just that, although miles of red tape still block the way. ITT has made some headway with its Dialcom service, which allows limited international mailbox service.

MCI Mail has a laser printing site in Belgium that is used to produce paper copies of electronic messages, which are then placed into the European mails for delivery.

Sooner or later, the Global Village will be truly electronic. Next we'll have to figure out something to say. ■

"The guy in the movie gets to play 'thermonuclear war'. All I ever tap into is Acme Plumbing."

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Standard RAM	512K	256K	512K	256K
Number of Keys	95	95	59	89
Mouse	Yes	No	Yes	Yes
Screen Resolution (Non-Interlaced Mode) Color Monochrome	 640 x 200 640 x 400	 640 x 200 720 x 350**	 None 512 x 342	 640 x 200*** 640 x 200***
Color Output	Yes	Optional	None	Yes
Number of Colors	512	16	None	4096
Disk Drive	3.5"	5.25"	3.5"	3.5"
Built-in Hard Disk (DMA) Port	Yes	Yes	No	No
MIDI Interface	Yes	No	No	No
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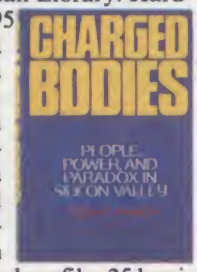
BOOK REVIEWS

Russ Lockwood

Charged Bodies: People, Power, and Paradox in Silicon Valley by Thomas Mahon. New American Library. Hardcover, 339 pages, $15.95



Thomas Mahon, a public relations consultant with clients in the Silicon Valley area of California, conducts a broad sociological study of this 200-square mile high-tech area. He interviews and profiles 25 luminaries, including Robert Noyce, co-inventor of the integrated circuit and co-founder of Intel; Alan Shugart, of Shugart and Seagate disk drive fame; George Morrow, founder of Morrow Designs; and Arthur Rock, venture capitalist.

Mahon probes beyond simple narrations of well-known success stories and offers insights from observers who are part of the "microculture" yet on the fringe of the mainline computer industry. Lawyers, financiers, environmentalists, artists, theologians, and even a private detective recount anecdotes, impressions, and details of Silicon Valley life.

Mahon flits from one story to the next, making his prose mimic the free-wheeling atmosphere of this high-tech environment. New topics appear as fast as new products, keeping *Charged Bodies* highly charged.

The book provides a snapshot of Silicon Valley life. Readers will be able to glimpse the aura of the area and feel the delights and despairs of the people who make up this high-tech society. *Charged Bodies* satisfies those who want a light touch on the more human side of technology.

The Regis Touch by Regis McKenna. Addison-Wesley. Hardcover, 179 pages, $15.95

When Apple Computer, Intel, Genentech, and Businessland want marketing advice, who do they call? Regis McKenna, the president and founder of Regis McKenna Inc., an international marketing consulting firm. As Apple President John Sculley notes, "When Regis speaks . . . Apple listens."

The Regis Touch compiles the marketing ideas of McKenna in one volume. In the book, McKenna details his favorite philosophy: dynamic positioning—how to portray the product, the market, and the company—in the creation of new markets instead of sharing old ones. He outlines the process of developing a marketing strategy and discusses the ten main reasons why such plans fail. Finally, he offers a true insider's look at the initial marketing of the Macintosh.

Most readers will find the information within useless—after all, the book is geared for marketing managers, not consumers. And we would really like to see a retrospective look at the Macintosh campaign, especially in light of insignificant corporate sales and generally flat sales overall.

However, many of *Creative's* readers will find the insight fascinating, as executives apply McKenna's ideas to their office work and individual software developers realize the importance of marketing their products. For these people, *The Regis Touch* may well become the bible of marketing.

Jazz on the Macintosh by Joseph Caggiano and Michael McCarthy. Sybex Computer Books, 2344 6th St., Berkeley, CA 94710. Softcover, 431 pages, $22.95

The first *Jazz* "how-to" book hit the stands just as the software hit the computer stores. We are not convinced that the initial incarnation of *Jazz* is the panacea for computerphobia and slow Macintosh sales (see John Anderson's review in this issue), however, if you did pick up *Jazz*, this book proves to be a natural companion.

Each chapter provides both a quick tutorial and a detailed reference section. Profusely illustrated and filled with examples, the book also offers tips and tricks to help you wring the most out of *Jazz*.

Traditionally, "how-to" books on specific programs duplicate the manual. *Jazz on the Macintosh* is no exception and you can probably skim through much of it. However, the tips and tricks within, combined with the clear explanations of some of the murkier aspects of *Jazz*, create a valuable supplement to the manual.

The NECEN Voyage by William S. Davis. Addison-Wesley. Softcover, 234 pages, $9.95

Do you remember the old movie, "Fantastic Voyage"? Through feats of technological wizardry, a team of scientists and a ship shrink to microscopic proportions, enter the human body, and perform a delicate operation. If you enjoyed that show, you might be interested in *The NECEN Voyage*. Through feats of technological wizardry, a team of computer scientists and a ship shrink to bytesize proportions, enter a computer system, and foil the plans of a megalomaniacal hacker.

In this combination science fiction/computer education novel, Georgie Hacker takes over the Northeast Central computer (NECEN) that controls all communication and transportation systems between Boston and Washington D.C. A crack team, complete with programmer Ada Byron and hardware designer Ned Lud, are reduced inside an eight-module ship and sent (via satellite) to enter and retake control of NECEN.

As a science fiction novel, the prose receives poor marks. Wooden characters, bland descriptions, and inane dialog make reading this book a tedious chore. The book has some value as an introduction to computers, but the material covered is too basic and too hard to ferret out to be considered worthwhile.

If you want a science fiction novel, buy the outstanding *The Many Colored Land* series by Julian May (Del Ray, New York). If you want to become computer literate, pick one of the good introductory texts already reviewed here. *The NECEN Voyage* is a brave attempt to combine the two. Unfortunately, it falls far short of covering either. ■

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Megabucks for Megaflops

Uncle Sam boosts the supercomputer market/**David Lytel**

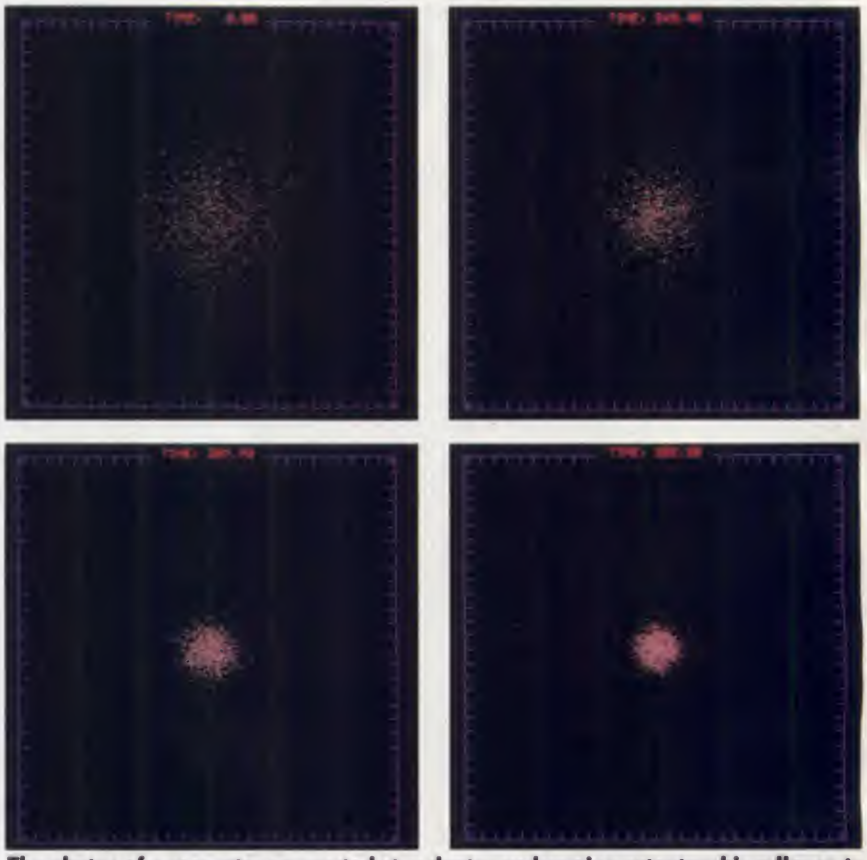
Forget miniaturization," says the cartoon on Kenneth G. Wilson's door, "I want to build a really big computer." Wilson is professor of physics at Cornell University and winner of the 1982 Nobel Prize in physics. And thanks to a National Science Foundation award announced recently, Wilson and Cornell will soon be building a really big computer—one that will be 40 times faster than anything available today.

Cornell is one of four universities designated to share the $200 million NSF grant. The others are the University of Illinois at Champaign-Urbana, Princeton, and the University of California at San Diego, Cornell.

The supercomputers created as a result of the grant will be used for modeling complex systems—everything from studying black holes to forecasting the effects of numerous variables on the world economy. Simultaneous equations with thousands of dynamic variables can be created, so processes that are too elaborate to reproduce in a lab or too complicated to describe on paper can be studied. Atmospheric models built with data from Voyager missions to Jupiter and Saturn will be explored to enable scientists to learn more about the surface and environment of these planets. Geologists will be able to build a comprehensive model of the "earth engine" that moves the continents and produces mineral deposits.

How fast does a computer have to be to qualify as a supercomputer? Like other performance standards, this one changes frequently. For a long time the industry standard was the Cray 1, but the current top-of-the-line supercomputer is the Cray XMP/48. In the past, a supercomputer performed in the range of a few hundred megaflops (million operations per second). The Cray XMP/48 is capable of close to one gigaflop—a billion operations per second. Wilson's goal for the Cornell computer is 40 gigaflops.

The first system that will be installed at Cornell is an IBM 3084-QX mainframe connected to four Floating Point Systems scientific processors; its performance is in the range of the current Crays. A second system is expected to be installed within the next year or two. "We can't discuss it in detail, because the information is proprietary, and it is all based on very high risk development projects, so it is difficult to predict the timing," says Wilson. "But we expect it to be highly parallel with lots of processors operating simultaneously."



The photos of a computer generated star cluster undergoing catastrophic collapse to a black hole. The images shown at various times during the collapse, were generated on Cornell's superminicomputer, the FPS 164 Array Processor by Professors Stuart L. Shapiro and Saul A. Teukolsky. The motion of the stars is governed by Einstein's Theory of General Relativity. The collapse of clusters with over one hundred million stars in the centers of galaxies may trigger the birth of quasars and AGNs. (Photos courtesy of Stuart L. Shapiro and Saul A. Teukolsky.)

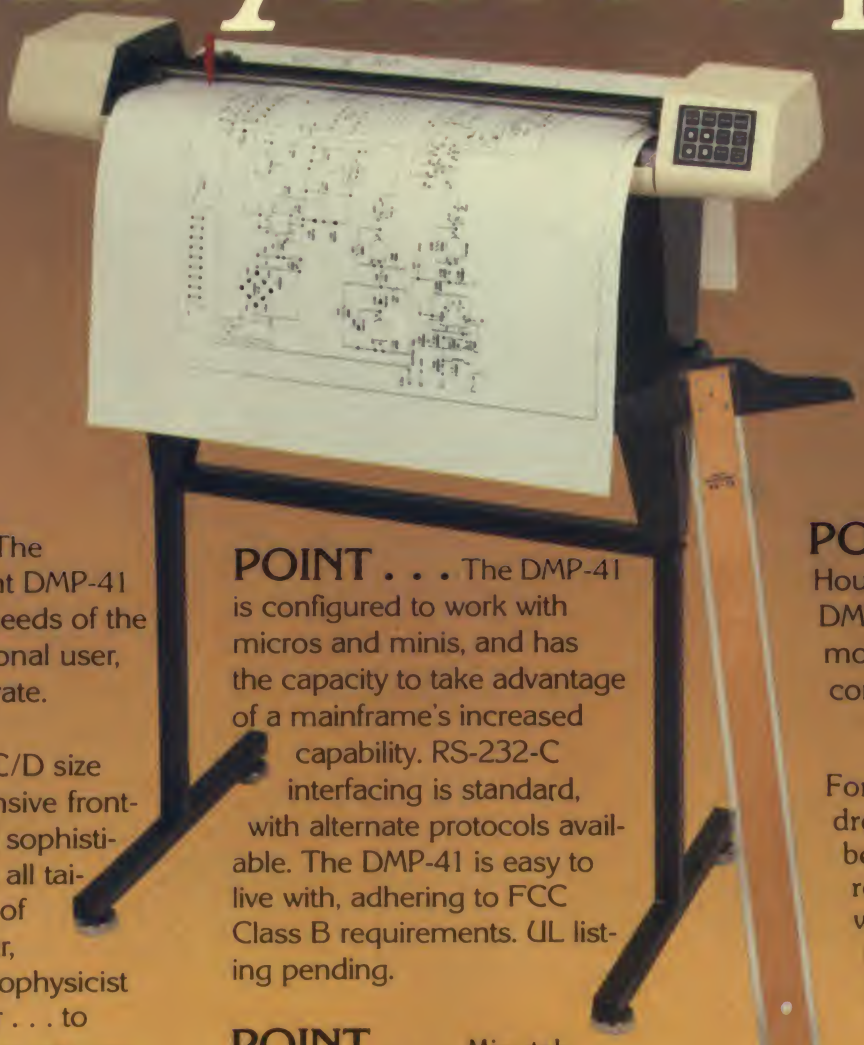
The Importance of Being Parallel

Parallel processing, the solution of several pieces of a problem at one time, is more than just another hardware consideration. According to Wilson, the experiments in parallel architecture will be critical in lowering the price of supercomputers and increasing their availability. "What we are trying to do," says Wilson, "is get a new generation of machines out and on the market. We are putting pressure on industry to lower entry level prices on the next generation of supercomputers to less than $100,000. Now that doesn't mean that you will get a lot for $100,000; the important thing is that people will be able to get started for that sum and then increase their computing power through upgrades rather than having to start over with a totally incompatible system."

Parallel processing plays an important role in this concept, because it allows the user to upgrade simply by adding processors. There is always a more powerful machine on the horizon, but at any step along the way, he has a reasonable computer.

This attempt to extend parallel processing and the collaboration between IBM, which has pledged $30 million in equipment and staff time to the project,

It's easy to make points when you're a pro.



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and Cornell are the two aspects of the project that are arousing the most interest in the computer industry. Supercomputers are virtually the only computers that IBM does not currently manufacture. According to Wilson, "IBM is clearly becoming very concerned about the needs of the scientific and engineering market."

Jack Kuehler, who heads IBM's large computer development efforts, says that the Cornell approach is just one option the company is exploring in supercomputer design: "Through this joint research with Cornell, we hope to gain experience with parallel processors in large scale scientific operations."

Replace Fortran?

Concurrent with the parallel processing aspect of the project at Cornell, researchers are attempting to build a language to replace Fortran as the language of scientific computing. The problem with Fortran, according to Wilson, "is that the logical ideas that a scientist or engineer wants to express get all scrambled up in the computer program. You have to weave back and forth through the listing to figure out what is going on."

Wilson's team hopes to build a language called Gibbs that will allow scientists to express their ideas in a coherent fashion; through programs written in such a language, scientists could communicate with each other as they currently communicate through scientific papers and textbooks."

Spinoffs

Wilson expects the supercomputer grants to produce many opportunities for researchers to spin off new businesses. He cites as an example his brother, who was assigned the problem of designing a data acquisition system for an Apple computer while at Harvard. "A person working in biochemistry bought an early Apple and wanted to use it in his lab; my brother was given the task of building a device to connect the Apple to the apparatus." Having designed and built the system, Wilson's brother and some friends left Harvard and set up a company. "What is important," says Wilson, "is that they had a head start. When Electronics magazine did its first survey of data acquisition systems for personal computers, there were two companies at the top of the list, and my brother's was one of them."

That process will be repeated with the supercomputer market, Wilson thinks. "People will get involved in solving a specific problem as part of making the system work. They will then have to have the guts to use their knowledge to make a marketable product. They will have had an early look at some of the problems presented by the new technology, and they will be able to build a small company to serve a growing market. Timing is everything."

Whether the universities that have received these powerful new machines will serve as incubators for ideas that become commercially viable remains to be seen. "There is a certain infrastructure that exists around Boston and Silicon Valley that must be developed," says Wilson. In New York, the former chairman of the State Urban Development Corporation expressed some skepticism at the ability of the new supercomputer centers to become the focal points for coordinated economic development efforts. "New York has more than its share of important companies and universities," says William Stern. "But we have failed to bridge the gap between research in universities and commercialization in companies. Maybe Cornell will change that." ■

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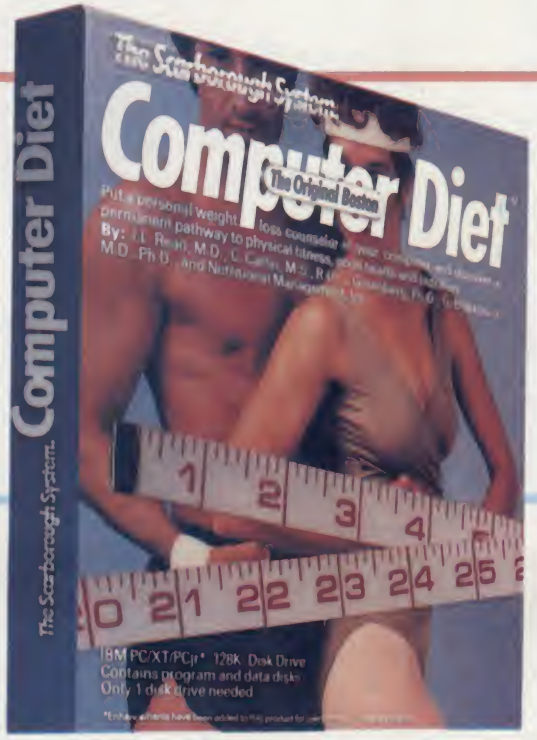

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Display: 640 x 400 (monochrome), 640 x 200 (4-color), 320 x 200 (16-color)
Disk Drives: 3.5" external floppy, single-sided, 360K, two maximum
Ports: Parallel, serial, DMA access (hard disk), MIDI in and out, dual mouse/joystick ports, ROM cartridge jack
Operating System: TOS (proprietary)
Documentation: Not available at press time
Summary: Not much to run on it now, but unquestionably a real contender
Price: $799, bundled with single external floppy drive and monochrome monitor; $999 bundled with floppy and color monitor
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Photography by Jeff MacWright.

Atari owners are a special breed of computer enthusiasts. They have always found it an uphill battle to defend their choice, despite the fact that the hardware is demonstrably superior. Like the sound of seagulls at the beach, the cry "not just a game machine!" tends to fill the air in any room full of Atarians. Tiresome, perhaps, but oh so true.

I am proud to consider myself a member of the small but outspoken group of Atari loyalists. It might not have happened but for my tenacity in purchasing an Atari 800.

It was a habit of mine back in the spring of 1980: during my lunch hour, I used to walk over to a computer store on Lexington Avenue to play with the Apple II computer on display there. I was saving for an Apple and, in fact, had managed to cull $800 from my meager salary toward buying it. I was nearly halfway to the purchase price, and beginning to get really excited.

One fateful afternoon, however, my sentiments changed. For after a few rounds of monochrome *Lunar Lander* on the Apple, I noticed a new machine lying neglected in the corner of the store. I will try to reconstruct the nature of the conversation as best I can.

Power Without the Price

"What's that you've got over there?" I asked the salesperson innocently.

"Oh that's nothing. Its just the new machine from Atari. You know, the people who make Pong."

"Huh. Got anything to run on it?"

"Not really. Just this space game."

He tossed me a ROM cartridge. I had never seen such a thing before. It took me a few minutes to hook the computer up and discover how to plug in the cartridge. No help was proffered. The salesperson obviously hadn't spent a solitary moment with the machine.

I was immediately impressed with how simple the thing was to use. No cryptic commands, no ribbon cables hanging out the back, no disk directories to call up. I shut the cartridge door, and in a split second the title screen came up. *Star Raiders* was the name of the game. I picked up the joystick and began my love affair with the Atari computer.

"How much is this?"

"You don't want one of those. They won't last through the year, and then you'll be high and dry."

"How much is it?"

"It's $800, but I'm not going to sell one to you. You want an Apple II, and I'm going to save you from yourself. The Atari is just a game machine . . ."

Well, you get the idea. I literally had to force the guy to sell me an Atari 800, and he "tsked" at me on sight for the next two years. But I had bought the most advanced personal computer available at the time. And it was not just a game machine.

Much has happened during the ensuing five years, not the least of which is that Atari slid from one of the greatest success stories in American business to one of the greatest case studies in American business failure. Their problems were manifold, and I have related them at length in the pages of *Creative Computing* since 1982. Certainly, however, among their primary problems was the fact that over those five years there was no significant improvement in the product line.

Until now. Under the stewardship of the family Tramiel, Atari has risen Phoenix-like from its own ashes, with a machine as truly innovative today as the 800 was in 1980: the Atari ST.

Hardware

The Atari ST has been designed to move the power associated with machines costing thousands of dollars into the range a middle class consumer can afford.

It is based on the Motorola 68000, clocked at 8 MHz. It ships with 520K,

theoretically expandable to a whopping 16 Meg. It includes parallel and serial interfaces, and a DMA (direct memory access) port for hard disk and other peripherals. Also featured are an external floppy port, MIDI input and output, two mouse/joystick ports, and a 128K ROM cartridge port.

Back end sports serial, parallel, DMA, and MIDI I/O ports.

The keyboard is a 95-key full stroke in Selectric configuration. It sports a separate numeric keypad and ten programmable "French-cut" function keys. The cursor control keys are laid out in VT 100 terminal style and are easy to get used to.

Three display modes are available, each with a 32K bit map. Lo-res color graphics are capable of 16 simultaneous colors from a palette of 512 in a resolution of 320 x 200 pixels. Medium-resolution color offers four colors with a resolution of 640 x 400. In both modes, a call to BIOS can change the palette on the fly—even by the scan line—to call up to all 512 colors simultaneously on a single screen. Text sizes available from these modes are 40 x 25 and 80 x 25 respectively. The output is RGB analog.

The third graphics mode is hi-res monochrome, offering a resolution of 640 x 400 pixels. It refreshes at 70 Hz, which is ten more cycles per second than conventional displays. The result is the sharpest, most legible display available on the consumer market today. Monochrome text resolution is also 80 x 25, but the tech wizards at Atari have already pushed this to a slightly cramped but legible 80 x 50.

The disk drive itself is an external, 3.5", single-sided, dual density drive, capable of storing 360K. Atari also plans a dual-sided drive. The system supports a maximum of two floppy drives. They are a little noisy, but very, very fast.

In its current incarnation, the Atari ST sports a mere 16K of boot ROM. The sockets are onboard, however, awaiting a ROM version of TOS, to be delivered in the late fall. This will eliminate the wait for a system disk to load (about 35 seconds) and free all 520K RAM for programs and data.

Four custom chips inside the ST help give it the amazing processing power it boasts. They are a graphics chip, DMA chip, memory manager chip, and Glue, which incorporates a number of ancillary housekeeping chores. Glue also replaces a number of off-the-shelf components, saving money and space under the hood.

System architecture was designed to interleave cycles between the CPU and the graphics chip to maximize throughput. Unburdened by graphics and housekeeping chores, the 68000 mpu can attain speeds comparable to a VAX mainframe. The ST is a formidable muscle machine.

The mouse is a two-button mechanical device in the Xerox PARC-style. The second button adds functionality to the point-and-click peripheral, putting more options at the literal fingertips of the user.

Sprite graphics are missing from the ST, but are rendered obsolete by the bit-blitting capability of the machine. This technique allows chunks of memory to be designated as shapes, which can then move on the screen independent of the background field and without the constraints that limit the size and multicolor of ordinary sprites.

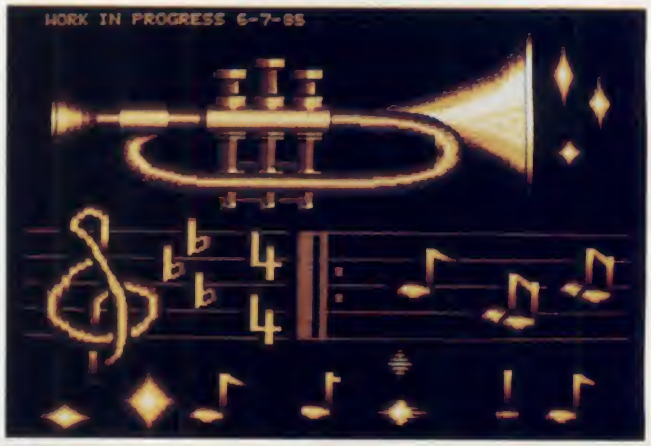
The ST includes a General Instruments sound chip, built to the MSX specification. This means three channels of pure tone audio, across nearly the entire audible octave range, plus a noise channel. Several pre-programmed waveforms are available, along with some envelope customization capability.

Far more powerful, however, is the built-in MIDI interface, which will connect the ST to dedicated music machines. Through the MIDI ports, the ST can control a limitless number of MIDI devices, including drum machines and MIDI-equipped tape decks, offering a powerful tool to the professional musician and serious hobbyist as well. It is also quite possible that the MIDI input and output jacks of the ST could be harnessed in unique ways beyond the scope of a music interface.

A large number of exciting hardware peripherals have been announced. These include a 550Mb CD-ROM drive at $500; a 1200 baud modem for $150; a 720K dual-sided floppy drive for $200; and a 10Mb hard disk drive for around $600. Haba Systems has announced its own 10Mb hard disk, as well.

Software

Official word has it that TOS, the name of the proprietary ST operating system, stands for "The Operating Sys-



Photography by Jeff MacWright.

Atari ST Logo windows in monochrome.

tem." We're willing to accept that if you are. It consists of six program modules: Desktop, which keeps track of windows and icons; DOS Manager, which handles the disk drive; BIOS and BDOS, system modules common to MS-DOS and CP/M; VDI, the virtual device interface; and AES, applications environment services. These constitute GEM, the desktop metaphor interface for the ST, developed by Digital Research. GEM makes the ST look and work much like a Macintosh or Xerox mini, and we'll explore it more fully up ahead.

Bundled in the hardware package in its current configuration is a TOS disk and Atari ST Logo. Logo is similar to DR Logo, but has been optimized to take advantage of the windowed GEM environment. Announced for shipment soon are Atari ST Basic, which will be similar to Digital Research's Personal Basic. It has fewer hooks to GEM, but does feature windowing. Atari ST Forth as well as 4xForth will be offered to Forth programmers. Two versions of C are set to ship as well: DRI-C and Hippo-C, the latter to be distributed by Haba. A version of ported Pascal is floating around developers' circles right now, but no formal plans have been announced for commercial availability.

You don't have to be terribly astute to notice the connection between the Atari ST and Digital Research, the developers of GEM. DR is also developing three packages for the ST. *GEM Write*, which we are told is very nearly finished, is a word processor in the spirit of *MacWrite*. *GEM Paint* is a paint program, which looks like *MacPaint*, except in color. *GEM Draw* is an advanced drawing program for the graphic arts.

Rising Star will convert its line of Valdocs software, usually associated with the Epson QX series of microcomputers, to run on the ST. The line includes a word processor, spreadsheet, database, terminal package, and drawing package. Along with Hippo-C, Haba is developing five packages specifically for the Atari ST: a word processor, a file manager, a spreadsheet and business graphics package, a checkbook balancer, and a terminal package. Haba has also voiced a commitment to translate its existing and future Macintosh releases to run on the ST.

The company Batteries Included has remained as faithful to Atari as any independent software house possibly could, even back in the dark days when Atari itself was unappreciative of such loyalty. They have professed belief in the power of the ST and are developing several integrated software modules for the machine. These include a word processor with built-in spelling checker, a database package, a spreadsheet, and a portfolio package.

VIP Technologies has announced a $100 *Lotus 1-2-3* workalike for the Atari ST, which offers the full utility of Lotus' information management with the point-and-click ease of GEM.

Even if you own a "not just a game" machine, it is sometimes fun to play a game or two. And the ST will have its share of those as well. Infocom has committed to translations of all its popular adventure titles for the Atari ST. SubLogic is custom developing a super flight simulator program, to take full advantage of the graphics and animation power of the machine. FTL Software is working on a version of *Sundog*, its science fiction role-playing adventure for the Apple II series, said to be a knockout in its ST incarnation.

The submarine simulation *Gato* is being translated for the ST by Sierra Online, and Datasoft has announced two games for the machine, one based on the film "Goonies." We have also heard that an arcade-quality version of the game *Joust* is being prepared for the Atari ST by a company called Rugby Circle.

By far the most exciting game possibility we heard about, from a highly reliable source, is that of *Star Raiders II* for the ST. One can only hope that this becomes a reality. Of course Atari must be careful in this, lest its new high-powered product again be stigmatized by the label "game machine." But it would be entirely fitting, I think, to tailor a new advance in the state of the software gaming art to accompany such an advance in new-generation hardware. History would do well to repeat itself in at least that one respect.

In the monochrome mode (left), the display matches screen resolution of the Macintosh. In color (middle) horizontal resolution is cut in half, but defaults are alterable via the control panel (right).

The Hands On

I could hardly contain my enthusiasm when the ST arrived at the lab; imagine my disappointment when I could not get TOS to boot. Once again I was pulled out of a tight spot by my good tech buddy Sheldon Leemon, who had experienced the problem himself. The fix was simple: reseat the chips on the motherboard. Unfortunately, this required disassembly of the system unit and removal of the RF shield, which requires a bit of desoldering. Fortunately, I am assured by Atari that this malady occurred only with the earliest production models (we have got serial number 1080). The machine you buy will not suffer the problem.

The only problems that you might identify are rather nitpicky. I am not entirely satisfied with the touch of the keyboard, which I might describe as "mooshy." Also, I felt discriminated against as a left-hander, because the mouse cable is too short to be moved comfortably to the lefthand side of the system unit. Luckily, I happened to have handy an Atari spec joystick extension cord, which worked just fine to extend the mouse cable from its port on the right of the system unit.

The external power supplies for the computer and disk drives are big and bulky. The disk drive power switches are on the back of the drives, which means trouble if you want to tuck them in under a shelf. They sport no power lights, and it is easy to forget to turn them off, especially if you are used to the Mac external drive, which has no power switch.

The most disconcerting aspect of my review process, however, was the sheer dearth of software to explore with the new machine. I was especially disappointed that no Basic was available at press time. I tried running the Ahl Benchmark out of Logo, but the results were so slow, I will not report them here. I am sure they reflect the overhead of windowed Logo rather than an accurate representation of the power of the Atari ST, which is lightning fast.

GEM: How Many Karats?

Then there is the GEM environment itself. While it is a remarkably capable implementation of the desktop metaphor, it is certainly no match for the Mac, and for that reason you will never see the word "Jackintosh" in *Creative Computing* magazine. Much of GEM seems very Maclike, but the fact is, the more you play with it, the less satisfying a substitute it reveals itself to be. You cannot move icons freely—they can only be copied or deleted. And don't try to move an icon onto the desktop. When you move an icon into a folder, it copies, leaving you to delete the original.

Things get worse if you want to move something out of a folder. Folders do not open into their own true windows, but rather usurp the window in which they reside. This means that to move an icon out of a folder, you must first copy it to another volume, then close the folder window, then copy the icon back to the original volume outside the folder. Finally, you can delete the copy inside the folder. Rather a primitive approach to the electronic desktop.

And while you are deleting, watch out for that trash can. Once you have thrown something in there, it's gone. You can set the ST to confirm the delete, but unlike the Mac, you cannot double click the ST trash can to look inside. Perhaps it would have been better depicted as a shredder or sink drain.

The feel of GEM is far from the Mac as well. The mouse moves smoothly, and it is easy to position the pointer. But accurate double clicking requires a bit of practice, and point-and-click with GEM just doesn't feel as good as it does on the Mac. Nor do you get that pinpoint accuracy when moving or sizing windows. I can't help but draw the analogy of the feel of a Toyota Corolla compared to a Rolls Royce Silver Shadow. But heck, I drive a Toyota Corolla anyhow, and I am happy with it.

The thing that annoyed me the most in my exploration of GEM was the way menus pull down the moment a pointer nears them. Perhaps this is another facet of my habituated experience with the Mac, but I just don't think that menus should pull down without a click. It is all too easy to overshoot an icon or windowbox up at the top of the screen and end up staring at a menu. To make it go away, you must pull the pointer out of the menubox and click. This was a mistake in the design; it could be easily corrected by requiring a click as does the Mac.

Kill the Critic

But let's be reasonable. Should a reviewer fault a Corolla because it doesn't roll like a Rolls? Absolutely not. The fact is, the Atari ST delivers 75% of the splendor of the desktop interface at 25% of the price of a 512K Macintosh. As it is currently packaged, a 520 ST with hi-res monochrome monitor and single disk drive lists for $799, which makes it without question the most advanced, most powerful microcomputer your money can buy.

When you consider that a 256K Amiga (reviewed last month) with monitor will set you back more than twice as much, it may well be said that the Atari ST is fairly positioned to blow the Commodore Amiga right out of the water. After all, the Amiga is just a game machine, right? ■

Photography by Jeff MacWright.

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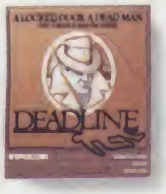

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And if you're clever enough, then maybe, just maybe, you'll prove your own innocence. But you'll have to hurry.

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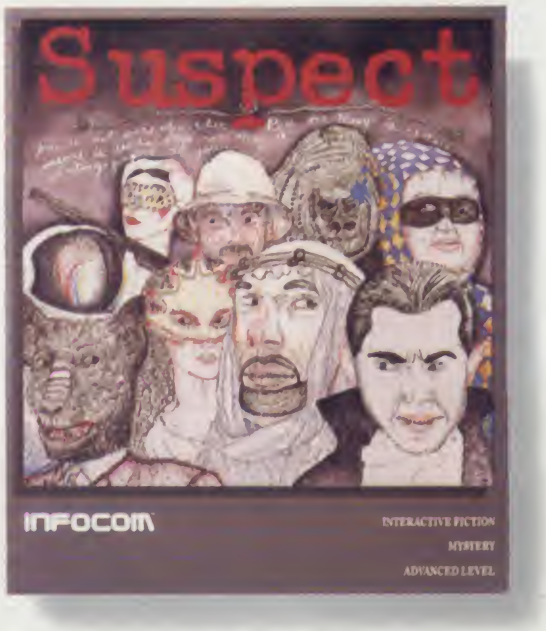

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Kaypro 2000

An MS-DOS portable with pizzazz/**Joe Desposito**

Looking as if it had just stepped out of a Calvin Klein collection, the Kaypro 2000 is the latest lap-top portable bearing the MS-DOS standard. Though Kaypro has sacrificed style for price in the past, the 2000 offers both. It is designed with the executive in mind, but is also affordably priced. Cost of the 2000 is $1995, which includes a hefty software bundle.

Overview

The Kaypro 2000 comes standard with a 25-line by 80-character liquid crystal display, one 3.5" disk drive, 256K RAM, and a serial port. Also standard is the MS-DOS operating system, a software bundle from MicroPro, the *Mite* communications package, and various Kaypro utilities.

The stylish 2000 has a dark grey brushed aluminum case with beveled edges and a rubber strip running around the perimeter. A handle is built right into the rubber molding at the back of the unit. When you open the 2000, the entire top lifts up to reveal the display, and the computer turns on automatically.

The keyboard sits in the front half of the case and can be removed. In the back half sits a 3.5" slimline disk drive. When you want to insert a disk, you release a lever at the top of the drive, and the drive pops up at an angle. Once the disk is inserted, you push the drive back down. (If you hate dentists, you might be intimidated by the whirring sound of the disk drive, which sometimes sounds like a low-power dentist's drill.) Each disk stores 720K. To the left of the drive is a compartment for storing two disks.

On the left side of the case is the RS-232 port, which uses the standard IBM male DB-25 connector. Underneath the case are two RJ-11 telephone jacks for an optional built-in modem, and a 100-pin connector expansion port.

Inside the Kaypro 2000

To maintain compatibility with the IBM PC, the Kaypro 2000 uses an 8088 CPU and a PC type system architecture. For example, the UART used for the serial port is the 8250—the one used on the IBM PC—rather than the CMOS version used on the Data General One. The 256K RAM can be expanded internally to 768K. Other features are a built-in real time clock and an 8087 socket.

The system uses battery power, but can also use an outboard AC adapter. Charging time for the battery is 24 hours, which powers the unit for four hours. This takes into account standard disk usage. However, if you rarely access the disk, battery power will last a lot longer. The battery charges whenever the AC adapter is plugged in, and it cannot be overcharged. There is no automatic shutoff feature.

The Display

When you open the case to see the display, two angles can be set for viewing. In both positions, I found the display to be readable but dark with normal overhead lighting. However, when I set a florescent table lamp over the screen, viewing was perfect, without any glare. There is no contrast control knob; instead you press CTRL-ALT and F1 or F2.

Although the display accommodates 25 lines by 80 characters, it does so in a space just 2.75" high (9" wide), so the characters look cramped. But the font uses two rows of dots to form letters, so characters are very readable. Lowercase letters like g and j do not really have true descenders, though they do drop below the line a bit.

In graphics mode the screen has a resolution of 640 by 200 pixels. In terms of compatibility with IBM PC software, the display functions like a PC with an IBM color card and monochrome monitor.

Kaypro 2000

Type: Lap-size portable computer **CPU:** 8088
RAM: 256K expandable to 768K internally
ROM: N/A **Operating System:** MS-DOS
Keyboard: 77 full-travel keys; detachable
Display Resolution: 25 lines by 80 columns; 640 x 200 pixels
Ports: RS-232 serial, expansion port
Dimensions/Wt: 13.1" W x 11.5" D x 2.6" H; 11.5 lbs.
Documentation: 12 manuals support the computer, operating system, and software
Summary: A fast, powerful MS-DOS portable that's great looking, too; a 5.25" add-on drive is recommended to run IBM PC software
Price: $1995
Manufacturer: Kaypro Corporation
533 Stevens Ave.
Solana Beach, CA 92075
(619) 481-4300

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Behind the Kaypro 2000

Creative Computing interviewed David Kay, vice president of marketing and sales at Kaypro, recently. He gave us some insight into the design and marketing of the Kaypro 2000.

Creative: The striking design of the 2000 is a radical departure from earlier Kaypro products. How did this design come about?

Kay: A company called Synerdyne came to us with the product and had the idea of building a completely modular computer. We were against that idea, but we worked closely with Mark Knighton of Synerdyne to modify the product to what it is today.

Creative: The display is much more readable than some competing products that use LCD screens, why is that?

Kay: It is because our screen has a better contrast ratio than some others, so you can read it more easily and from a wider angle.

Creative: Do you think people might buy the 2000 instead of the standard IBM PC?

Kay: No one (at Kaypro) expects anyone to buy the 2000 to do heavy-duty computing tasks. The idea of getting the price under $2000 is so that people will buy it for light and occasional use.

Creative: Who do you think will buy the 2000?

Kay: The person who uses his machine less than two hours a day; we figure that this can be his only computer. And it is not a workstation; nor is it intended to be. But there are millions of people who already own IBM PCs and who really want something mobile, that is small and IBM compatible.

The 2000 is almost an impulse buy for young professionals. A person who bought a PC a year ago and see that it has paid for itself three times over says, "What the heck, I can afford something new. This is neat. I can use it on the plane. And it's a $2000 buy." And, bang, he has it.

The Kaypro 2000, alone among laptop portables, features a detachable keyboard. Pop-up disk drive and on-board disk storage (left) are other designer touches.

Photography by Jeff MacWright.

Sleek brushed aluminum and rubber bumper strip (right) lend a solid feel to outer case.

The Keyboard

Unlike any of the other lap-top portables, the Kaypro 2000 has a detachable keyboard. This means you can remove the keyboard and maneuver the case to adjust the display to just the right viewing angle.

The keyboard has 77 full-travel keys, including 10 function keys along the top row. Though a separate numeric keypad is missing, it can be invoked by pressing the NUM LOCK key and using a color-coded keypad that is overlaid on the standard keys. The feel of the keyboard is excellent, though placement of the keys varies somewhat from the IBM PC format.

Expansion Options

One of the most powerful features of the Kaypro 2000 is its expandability. There are two ways to expand the system. One is with a disk adapter, and the other is with an expansion base unit.

If you want to add a 3.5" or 5.25" drive (or both) to the 2000, you will need the disk adapter ($150). The extra drive will cost $295. The disk adapter also contains a parallel port and can hold one short IBM PC compatible card (an RGB card could be installed so that a color monitor could be used at your desk).

The other option is a base unit that sells for $795 and includes two standard card slots, two half height slots for floppy or hard drives, a parallel port, and serial port.

Software and Documentation

The software included with the 2000 is really a bundle. There are the MicroPro products: *WordStar, Mailmerge, CalcStar, InfoStar*, and *StarBurst*. Then there is *Mite*, a communications package from Mycroft Labs. And for programmers there is GWBasic. All of these run under the MS-DOS operating system. Additionally, Kaypro provides utilities. For example, K-Copy

allows you to copy files easily with a one-drive system.

Although this software selection provides most of the typical software a user might want, we are talking about an MS-DOS computer here, and MicroPro is certainly not king of the MS-DOS world.

It is natural to think that a potential 2000 user will already have purchased his favorite software (for his stand-alone machine) or that a first time user will be more likely to use software that has been established in his company.

So why the software bundle for this machine? I suspect that potential users will be more interested in tapping into their PC base of software than in using the bundled products.

Documentation for the software is plentiful, but it is not specifically geared to the 2000 user. Manuals from MicroPro, Microsoft, and Mycroft are generally excellent. The manual for the 2000 itself is less than 50 pages. It covers the basics of the machine and gives some brief technical data.

Compatibility

The Kaypro 2000 is intended to be almost 100% IBM PC compatible, though this assertion was difficult to test since we didn't receive a 5.25" drive. Manufacturers are not producing their software in two formats yet (in one package), and until they do, the 3.5" media will present compatibility problems.

Comments and Conclusions

I used the Kaypro 2000 with *WordStar* and it ran fast and without problems. I also downloaded a utility program from CompuServe using *Mite*. But *WordStar* is not my word processor of choice. I couldn't use my normal one because it is on a 5.25" disk. Although there are ways of transferring programs through serial ports, this process is sometimes a hassle. I would much prefer to have the 5.25" drive available.

Another problem with the 2000 is the single drive. When you are used to a two drive system, simple procedures like copying files become a burden. Also, some PC software products expect a two drive system.

I thought the machine performed excellently—in fact it seemed to respond much faster than a typical IBM PC. The drive was reliable and the screen legibility was acceptable.

If I were to purchase this machine I would certainly spend the extra money on the disk adapter and a 5.25" drive. This configuration would dispense with any software problems and allow the 2000 free rein to function as the powerful machine it is. ■

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Bondwell 2

Spectravideo rebounds with a disk-based portable for under $1000/**Joe Desposito**

An old cigarette commercial once proclaimed: "They said it couldn't be done; they said nobody could do it." For a time, this seemed to apply to lap-size portable computers, too. It seemed nobody could build a lap-top with an integral disk drive for less than $1000.

But now Spectravideo (reincarnated under the aegis of Bondwell Industrial Co. of Hong Kong) has done it. They have produced the Bondwell 2, a lap portable with a 25-line liquid crystal display and integral disk drive for a suggested retail price of $999.95. Bundled with the system are five software products from MicroPro: *WordStar, Mailmerge, CalcStar, DataStar* and *ReportStar*.

Overview

The Bondwell 2 is a CP/M-based computer with a 3.5" micro-floppy drive built in. The case is a two-tone gray color with a handle at the rear. When you flip up the front half of the case, the display and keyboard appear.

This is where problems normally start for these portables. You turn the thing on, look at the screen, and realize you can't see anything. But not with the Bondwell. The machine features an ingenious kind of hinge that allows you to accomplish something like a dancer's split with the display. It actually can tilt from 0 through 180 degrees. Thus, no matter what type of lighting you have, the screen can be easily viewed.

Along the rear of the computer are three ports, an RS-232 serial, Centronics parallel, and one for a second 3.5" disk drive. At the bottom of the unit is a connector for plugging in a modem or additional memory.

Inside the Bondwell

The Bondwell uses a CMOS version of the Z80 microprocessor. Though our review unit ran at 2MHz, production models will have a 4MHz clock. It has 64K RAM for program and data storage, 16K video RAM, and 4K ROM.

The 3.5" disk drive uses double density micro-floppies, offering 360K of formatted storage space. Although it sometimes seems that all 3.5" drives are manufactured by Sony, that isn't the case. The Bondwell uses Tec drives.

Power for the unit is supplied by two sealed lead-acid batteries. The batteries last about eight hours and then must be recharged, which takes 12 hours with the supplied adapter. A red LED on the outside of the case flickers when power is running low (it can be seen when the unit is open or closed). However, there is no automatic shut off feature, so if you leave the computer on and forget about it, you will undoubtably drain the batteries.

The Display Angle

As mentioned, the display can be tilted to any angle, which affords excellent viewing. However, the characters on the display are not a joy to read, because the font uses only a single row of dots to form the letters, and lowercase characters like j and g don't have true descenders. A contrast adjustment, however, adds to the readability.

In the text mode, the display accommodates 80 lines of 25 characters. In the graphics mode, the resolution is 640 by 200 pixels.

Bondwell 2

Type: Lap-size computer
CPU: 280C
RAM: 64K user RAM, 16K video RAM
ROM: 4K **Operating System:** CP/M 2.2
Keyboard: 55 full-travel keys, 8 function keys, 4 cursor-control keys
Display Resolution: 25 lines x 80 columns; 640 x 200 pixels
Ports: RS-232 serial; Centronics parallel; second disk drive port; I/O expansion slot
Dimensions/wt: 12.2" W x 11.2" L x 3.1" H; approx. 12 lbs.
Documentation: User's Manual, CP/M, WordStar, CalcStar, DataStar, ReportStar, ReportStar Reference, and Mailmerge manuals

Summary: A hardware bonanza with a few minor shortcomings
Price: $999.95
Manufacturer: Spectravideo, Inc.
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Capable Keystroking

The Bondwell keyboard has an excellent feel. Touch typists should be able to breeze along at their fastest rate. Alphanumeric keys are light gray, while RETURN, SHIFT, TAB, and others are a dark gray color.

For cursor movement there is a cluster of triangular keys in the top righthand corner of the keyboard. And along the top row are ten half-size keys: the ESC, DELETE, and eight function keys. By using the SHIFT key with the function keys, you can program eight additional functions.

Software

The Bondwell 2 is packaged with CP/M 2.2 system and utilities disk, the five MicroPro packages mentioned before, and a *Scheduler Plus* disk. This software bundle provides most of the day-to-day software you would ever want. One drawback is that a high-level language like Basic is not included with the system. Thus, the only programming that can be done is in assembly language. Another drawback is that an operating system like CP/M and programs like *WordStar* might be somewhat intimidating to new users.

Documentation

The Bondwell 2 documentation includes a manual for beginners on the computer itself, a CP/M manual from Digital Research, and MicroPro manuals for that company's software. The manual provided by Bondwell is not of the highest quality, but it is clear and straightforward. And it contains some useful technical information like pin assignments for the I/O ports. The Digital Research CP/M manual is written for sophisticated users, and is very helpful for those who may want to do some assembly language programming. The MicroPro documentation is for beginners through advanced users and is excellent.

Observations and Conclusions

The Bondwell 2 has all the features a lap-size computer owner would ever want—at an affordable price. However, I think the hardware outpaces the software on this machine.

Although the machine is equipped to do almost anything, in practice I had trouble doing some elementary computing. For instance, it seems obvious that users would be interested in telecommunications with a product like this. However, the system disk that I received did not include a terminal program, and without a language like Basic available, you are left to write a terminal program in assembly language. However, a spokesman for Spectravideo indicated that the release version of the system disk will include Modem 7, a popular CP/M public domain communications program.

The other gripe I have with the software is that a product like *WordStar* runs very slowly on this system. The LCD screen is constantly being rewritten, which takes a good deal of time. The slower clock speed of the evaluation unit might have something to do with this, but I still think that *WordStar* on the Bondwell 2 will suffer from speed problems.

In my opinion, this kind of computer demands an awareness by the manufacturer of what the typical user will want to do with it. High on my list of uses for this computer would be telecommunications. Not only would I want to send and receive data files, but I would also be interested in tapping the vast library of CP/M software that is available. The manufacturer doesn't give the new user a clue as to how to do this. And experienced users are left to figure out ways to accomplish these tasks with the software that is provided—a serious oversight that could be easily remedied.

In conclusion, I think that the Bondwell 2 offers tremendous value to users interested in a lap-size computer with all the extras built in. However, tapping the power of this portable will require some effort. Those who are thoroughly familiar with CP/M and have an affinity for *WordStar* and other MicroPro products will be most easily pleased. The hardware is so impressive, though, that if you haven't already had a CP/M close encounter of the third kind, the Bondwell 2 may well provide the incentive for it. ■

Spectravideo Survives Chapter 11

It was the summer of 1983 when Harry Fox, then president of Spectravideo, made his "blockbuster" announcement. There was a new standard for home computers, he informed the world—the MSX standard—and Spectravideo would embrace it and profit from it. But MSX never took off and Spectravideo was forced into Chapter 11 within a year.

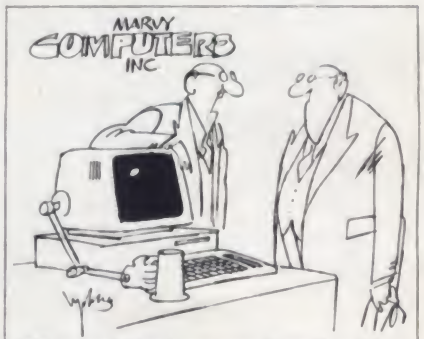
So what is the story behind the resurgence of a company that had seemingly drowned in a wave of financial troubles? Its comeback dates to May, 1984 when Spectravideo signed a letter of agreement with Bondwell Industrial Co. of Hong Kong. Bondwell, Spectravideo's major supplier at the time, was to increase its ownership of Spectravideo from 16% to 49%.

This agreement allowed Spectravideo to restructure $2.6 million of debt with the assistance of Bondwell. The company was then relocated from New York City to Fremont, CA. Harry Fox resigned as president, and Christopher Chan took over.

Chan remained as president until the spring of 1985 when two former Atari executives, John Constantine and Joseph Lacayo, were named president and vice president of sales, respectively.

The new Spectravideo is directing its marketing efforts to the Bondwell line of 8-bit CP/M based portable computers. In addition to the Bondwell 2, reviewed here, Spectravideo has announced the Bondwell 12, 14, and 16 transportables. But it has not forgotten its heritage. Spectravideo has reaffirmed its presence in the home computer market with joysticks, a solid source of revenue, and a recently announced MSX home computer.

Spectravideo's main strength with the Bondwell line is offering more features for less money. This is evident with the Bondwell 2, which along with the rest of the line, may attract enough customers to breathe life back into this once ailing company.



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PRINT ABOUT PRINTERS

Two alternatives to high priced daisywheel printers/**Owen Linzmayer**

Near Letter Quality is a favorite buzzword of today's printer salesmen, but what exactly does it mean? Just exactly how near is near enough? Well, it is difficult to say, but in our search for the answer to this question let's compare a low-cost daisywheel printer, the Juki 6000, to an NLQ dot matrix printer from Toshiba, the P351.

When a manufacturer claims that its printer has an NLQ mode, it is referring to the ability of the dot matrix printer to produce text characters that are so well formed that they look as if they were printed by a typewriter or daisywheel printer. The trick is to stuff as many tiny dots as possible into the small matrix used to create a character. The more dots per square inch, the greater the resolution and the better the print quality.

Resolution can be increased by using more pins in the printhead or by printing a line of text, advancing the paper a fraction of an inch, and then making another pass of the printhead slightly offset from the first. Both solutions have their drawbacks: using more pins means using thinner pins which are more susceptible to damage, whereas multiple passes of the printhead decrease print speed dramatically. Because using more pins also costs more, most printers on the market use the multiple-pass method to produce NLQ text. Some of the exceptions are reviewed by Bob Covington in the July 1985 issue. As a follow-up to that article on 24-pin printers, let's now take a look at the Toshiba P351.

Toshiba P351

Although it employs a 24-pin printhead, the Toshiba P351 is designed to act like a daisywheel printer. The output of the Toshiba rivals that of a daisywheel, yet this printer offers a host of other features that make it even more attractive to the user with a wide range of applications.

The Toshiba P351 is a handsome unit that sits 8.2" tall, 11.4" deep, and 20.4" wide. It accepts paper up to 15" wide and can be fitted with an optional tractor feed or automatic single sheet feed mechanism. The model I had for review didn't have either of these devices, so I resigned myself to using friction feed.

Shadow print
Underline
Elongated
Proportional
Prestige Elite
Courier
Proportional Elite
Draft Mode
Condensed

Type: Impact dot matrix
Feed: Friction (single sheet and tractor optional)
Speed: 288 draft cps, 83 NLQ cps
Interface: Parallel (serial optional)
Graphics: Qume Sprint 11, block, dot-addressable

Summary: Almost perfect letter quality, with a lot of extras
Price: $1699
Manufacturer: Toshiba America, Inc.
2441 Michelle Dr.
Tustin, CA 92680
(714)730-5000

Paper is manually inserted with the help of the paper guide included in the base price, but I soon discovered that this guide interfered with a unique paper handling feature of the P351. When the paper release lever is pulled forward, the platen rolls in an attempt to automatically advance paper into position. Theoretically, this is a great feature, but my experience is that the paper rarely advances to the correct position, and fan fold paper tends to entangle itself in the paper guide if you are not careful.

The front control panel of the Toshiba P351 includes the standard fare of select, top of page, and paper feed switches, with a side order of power, alarm, and paper end indicator lights. Adjacent to the Centronics parallel interface on the back of the unit is a bank of DIP switches that control the default print options such as paper size, font, and pitch.

Additionally, fonts can be selected by software. The Toshiba P351 recognizes three types of fonts: downloaded, cartridge, and resident (those that reside in the printer's ROM). Font cartridges plug into the rear of the printer and provide an easy way to increase the versatility of the P351. Alternately, you can create and download your own custom fonts directly from your computer with the appropriate software. Internally, the P351 has three resident fonts, one high speed and two high quality (Elite and Courier). These fonts, combined with the various features found only on dot matrix printers, such as italics and elongated print, produce a range of easily accessible type styles that no daisywheel printer can match (see sample).

The Toshiba P351 is also known as the "3-In-One" printer which, you learn by reading the manual, refers to its capability to print graphics in three modes: Qume Sprint 11 emulation, block, and dot-addressable. While the last mode is widely understood, the first two need further explanation.

Block graphics is sometimes called coded, or character, graphics. Just as each letter of the alphabet has a special ASCII code that represents it inside the computer, so there exists a set of symbols (blocks, triangles, squares, etc.) to which codes are assigned. Block graphics prints graphics the size of text characters and therefore cannot achieve high-resolution.

Originally developed to provide limited graphics capability for daisywheel printers, the Qume Sprint 11 standard uses the period character to form crude pictorial representations. This emulation was built into the Toshiba

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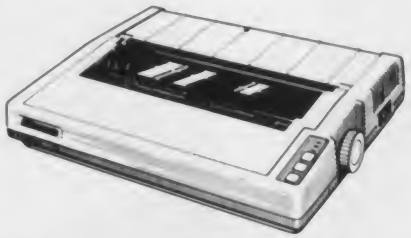
Premium Quality



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SALE **$229.00** SALE

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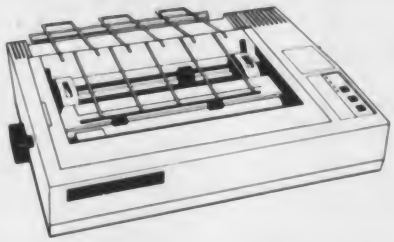

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SALE **$259.00** SALE

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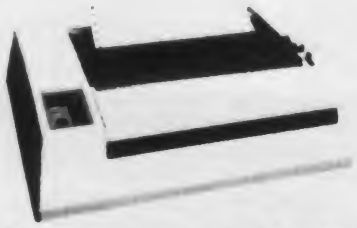

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P351 to insure compatibility with software originally designed to drive daisywheel printers.

I am particularly fond of the Toshiba documentation. This 150-page spiral-bound manual not only contains installation and usage notes, but includes technical information for the advanced user. Furthermore, a special appendix, which gives detailed instructions on how to interface and operate the P351 printer with most of today's popular personal computers, is provided. Heck, they even provide RS-232C cable configurations!

CIRCLE **404** ON READER SERVICE CARD

Juki 6000

Standard Text
Shadow Print
Bold Face
Underscore
15 cpi pitch
12 cpi pitch
10 cpi pitch

Type: Daisywheel
Feed: Friction only
Speed: 10 cps
Interface: Parallel or serial (Commodore optional)
Price: $295

Summary: It's not fast, but it does the job well
Manufacturer: Juki Office Machine Corp.
299 Market St.
Saddle Brook, NJ 07662
(201) 368-3666

Juki 6000

Sure the Toshiba P351 is loaded with features, fonts and the kitchen sink, but what if you are a lowly college student or computer novice who can't afford all those goodies? Well then the Juki 6000 daisywheel printer is for you. After all, why settle for *near* letter quality text when you can have the real thing for a lot less money?

Priced at $295, "the Juki 6000 is one of the smallest and most economical letter quality printers available," says Jerry Bitkower, Juki's general manager. Certain to be a hit with students and home users, the Juki 6000 offers inexpensive daisywheel print in exchange for slow print speed. Compared to the Toshiba P351 which zips along at 83 NLQ characters per second, the Juki 6000 is a relative snail at only 10 cps. However, a human being would have to be able to type 120 flawless words per minute to keep up with this daisywheel. Not an easy task.

The Juki 6000 is relatively small—and relatively quiet—compared to most daisywheel printers. Standing only 5.5" tall, the Juki 6000 has a footprint about the size of a Commodore 64 computer. Incidentally, if you want to hook up the Juki 6000 to a Commodore, you must buy a $49.95 convertor. The Juki 6000 can be purchased with either a Centronics parallel or an RS-232C serial interface.

Since it is a daisywheel printer, the Juki 6000 is limited to printing those characters that are present on its 100-petal daisywheel. The printer is supplied with a Herald Pica daisywheel, and additional fonts can be purchased for $17 each. Text can be printed at pitches of 10, 12, or 15 characters per inch, selectable via software. Installation and removal of both daisywheels and ribbons is a snap. Operation of the Juki 6000 is truly foolproof.

Designed to print only short reports and correspondence, the Juki 6000 does not have a tractor feed mechanism nor a top of form button. Friction feed is standard, as are the linefeed and on-line buttons on the front control panel. For $295 I didn't honestly expect to get a satisfactory daisywheel printer, but as you can see from the sample, the Juki 6000 prints perfect fully formed characters.

If you can live without the speed or paper handling features of higher priced daisywheel printers, the Juki 6000 should be a welcome addition to your computer system. It also offers those who already own an older dot matrix printer an inexpensive way to add letter quality text. For its class, the Juki 6000 represents an exceptional value, and I recommend it highly. ■

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CIRCLE 132 ON READER SERVICE CARD

Gall that Jazz

Lotus' Macintosh product is a clinker/**John J. Anderson**

Here's a riddle for you: What's worthy in its strategic concept, displays at least one intelligent and powerful feature, but is disappointingly weak in its execution, a case study in compromise, plagued by bugs and delays, obsolete at the time of introduction, and heinously overpriced? Well, the MX missile may spring to mind, but unfortunately, so might Lotus *Jazz*. And after the mushroom cloud of expectation, hype, and brand-identification blows over, the fallout will begin, mark my words.

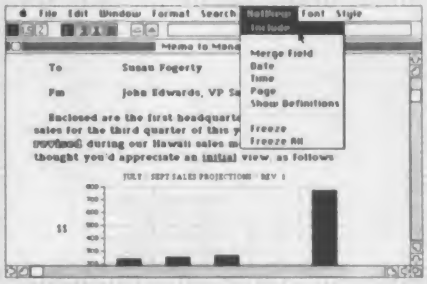
Sax and Violins

Don't overreact. There is nothing wrong with *Jazz* that a few healthy software revisions can't patch. Then again, not much of it is really *right*, either—right in the way it really should have been if it could have been. The problem is, it really couldn't have been—not with a top limit of 512K on the current generation Macintosh. Lotus is surely not to be blamed on that score—except for the fact that they went ahead and released a product that is really rather mediocre and sports a price tag of $600.

In case you have been locked in a refrigerated computer room since the introduction of the Macintosh, I should explain that *Jazz* is the integrated software package for the Mac from the people who brought us *1-2-3* and *Symphony*, two excellent integrated packages for the IBM PC. Like its brethren, *Jazz* features word processing, database, spreadsheet, business graphics, and terminal modules side by side, so you can slip from one to another without booting between programs. *Jazz* is unarguably the longest-awaited software package for the Macintosh, and the one upon which Apple itself has pinned its hopes—hopes that *Jazz* will help the Mac crack the business market, where it has come up hard against IBM. There is irony in that hope, as you will discover.

You must have a Fat Mac just to boot *Jazz*, and you must have an external drive, too. The program takes up 380K and must reside on two disks to coexist with system files. Therefore, you must cut your desk accessories down to bare minimum. Of course, not all program modules reside in memory simultaneously; some space (about 200K) must be left for your data (which can only reside in RAM—no virtual memory possible). Certain modules read only from disk when they are called, and this makes *Jazz* slow, slow, slow to execute from floppies. If you have a hard disk drive rather than an external disk you are somewhat better off.

Lotus Jazz



PERFORMANCE (–) (+)
EASE OF USE (–) (+)
DOCUMENTATION (–) (+)
UTILITY (–) (+)
OVERALL VALUE (–) (+)

System and Price: 512K Macintosh; external drive; $595

Summary: Overpriced integrated package has one bright spot, but is otherwise mediocre

Manufacturer:
Lotus
55 Cambridge Pkwy.
Cambridge, MA
02142
(617) 577-8500

CIRCLE **406** ON READER SERVICE CARD

If you thought MacWrite was a bare-bones word processor, you'll find the word processing module of Jazz positively austere.

Word Processing Module

If you thought *MacWrite* was a bare-bones word processor, you'll find the word processing module of *Jazz* positively austere. Although it does allow multiple document windows, which *MacWrite* does not, the module can support no document longer than 20.5 pages, and that only when *none* of the other modules is holding data. In other respects the module is a virtual *MacWrite* clone, the fact of which I found quite disappointing.

Database Module

The database module is another serious compromise. Its capacity is fair, allowing up to 100 fields of 254 characters per record, with a maximum of up to 1900 small-sized records. Data fields can be set in documents, so this module can merge into the word processing module. A serviceable report generator helps process database information.

Using the module is straightforward and simple, but don't look for the sophistication of a relational database. The fact is that the database module is rather like a spreadsheet with a fancy front end; its files consist of records and fields in a two-dimensional matrix.

Every time you want to add a record, you have to pull down a menu, as well, which is darned annoying. And don't try to store non-text data, because you can't. And don't try to size or move a report generator window, because you can't. The more experience you have with Macintosh, the more offensive you find this sort of inconsistancy in the user interface.

Spreadsheet Module

The spreadsheet module is one of the stronger facets of *Jazz*. It can handle up to 8192 rows x 256 columns. You can have more than one worksheet open at a time, and the ease of point-and-click really shines when constructing worksheets. But even this module is plagued by omissions. The least excusable is that no macros are possible—nor are split screens.

Business Graphics Module

The graphics module is by far the strongest element of *Jazz*, and remarkably, I found not very much wrong with it. Of course, Microsoft *Chart* is much more powerful, but this module is easier to use, and having a graphics program integrated with a spreadsheet is a real convenience.

Telecommunications Module

Just as the word processing module seems a subset of *MacWrite*, the telecommunications module seems a cloned subset of *MacTerminal*. In the case of the word processing module, at least the bare-boned grace of *MacWrite* seems to shine through. Unfortunately, *MacTerminal* was absolutely the wrong communications package to clone.

The *Jazz* module does work, and features an answerback mode as does *MacTerminal*. On the negative side, like *MacTerminal* it does not support auto-logon sequences or macros of any kind. It is clumsy to configure and clumsy to use.

MacTerminal was designed by a programmer who failed to understand the needs of telecommunications users, and as a practically identical subset of it, the *Jazz* communications module falls on its face as well. Worst is the fact that all incoming communications grind to a halt when you click to another window. Forget about getting something else done while data downloads.

HotView: The Saving Grace

I mentioned at the beginning of this review that at least one thing about *Jazz* was rather good, and it is possible that by now your curiosity is piqued as to what that one rather good thing is. It is HotView, which is the name Lotus has given to the *dynamic* clipboard feature of *Jazz*.

Alongside the regulation clipboard, which allows you to cut and paste static elements between windows, HotView lets you update graphs simply by updating the spreadsheet—or even update the graphs in a word processing document simply by updating the spreadsheet. Neat, simple, elegant, and truly hot! But is the feature worth $600? (To be droned in the singsong drawl of the late great John Belushi) Noooooo!

Having gained an acquaintance with Jazz, one may wonder if this fellow is breakdancing or has sustained some form of injury.

The Alternatives

So, where does that leave us? Well, I'm not about to recommend that anyone go out and pick up a copy of *Jazz*—at least not at its current price. Save up another $600 and buy yourself a hard disk drive. Then you won't need an integrated package—the drive is fast enough to move you between applications at a tolerable rate. After a RAM upgrade, a hard disk drive is the best next thing you can do for your Mac. Even with a Fat Mac with single drive and no hard disk, you can do better than *Jazz*, and I'll show you how.

First, get a copy of Switcher by Andy Hertzfield. Price: free. Under Switcher, you can run Microsoft *Multiplan* and Microsoft *Chart* side by side. You might even be able to cram *MacWrite* into the RAMdisk, if you don't need much space for your own data.

Then get the *Mock Package* desk accessories by Donald Brown. Price: $15, if you are honest—it's shareware. These give you word processing, terminal, and print driver modules in the form of desk accessories, which can be pulled down at any time, and share the desktop applications. By the way, the terminal desk accessory can continue to receive data even after you have clicked to another window.

Of course, there are other options possible as well. More powerful spreadsheets for the Mac, like *Crunch* (to be reviewed in a future issue) offer powerful graphics modules alongside high-powered worksheets. Careful planning of which two packages you want to run under Switcher, combined with truly useful desk accessories, can result in a desktop twice as powerful as *Jazz* for half the money, despite the lack of a HotView feature.

And once the shackles come off the ill-advised 512K current limit of the Mac, we will see Mac RAM memories in the 1 or 2Mb range. When this happens, two things will result: 1) The Macintosh will suddenly become a viable business machine, even with existing software, and 2) Lotus *Jazz* will list for under $300 and still be a slow mover.

Do Me A Favor

Please make a mental note that the only computer magazine on the market today with enough guts to tell you the honest, unadulterated truth about Lotus *Jazz* is good old *Creative Computing*. And remember, even if you own *Jazz*, things could be worse—at least you haven't bought toilet seats from the Pentagon. ■

APPLE CART

The matter of and with Macintosh/**John J. Anderson**

After my negative review of *Jazz*, I feel more than a little bit like the boy who yelled "the emperor has no clothes," and as a Macintosh devotee that leaves me feeling somewhat melancholy for at least four good reasons.

Contrition by Subtraction

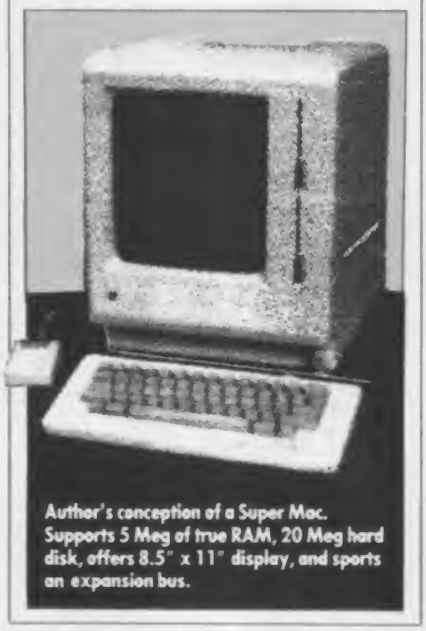
First, it bodes ill for the field of microcomputer journalism. Because computer magazines depend on advertising revenue to produce their product, they are loathe to antagonize a company as large and important as Lotus. So they sacrifice objectivity and shirk their primary responsibility to readers to provide the potential buyer of a product with a basis for an informed purchasing decision.

Nowadays, with so many computer-specific magazines devoted exclusively to a single product line, I have consistently seen objectivity shoved into chauvinism, and journalism pumped into propaganda. I am beginning to wonder if people can even tell the difference anymore. It would certainly make my job easier if I were sure no one could—it would be easy to tell you only what I know you want to hear. It is more difficult to state the truth when one's survival is at stake.

Second, it reflects poorly upon Lotus. They are a highly reputable firm that has invested a great deal of time and money in *Jazz*. The list price of the product simply represents that effort. As I stated in the body of the review, it is not really Lotus' fault that *Jazz* is a mediocre product. They did the best they could under the constraints of the problem, and now they are stuck with a package that disappoints mainly because of the lid Apple has literally screwed (using nonstandard, recessed screws) on to the Mac. I therefore feel queasy about taking Lotus to task, and I also lament their current position, hawking the thing with a multi-million dollar media blitz.

Third, I feel sorry for the unwary buyer. After seeing the hotly cool *Jazz* commercial on TV, the slick four-color spread in *Esquire* and the *New York Times Sunday Magazine*, glowingly positive reviews of the product in Lotus magazine (that bastion of objectivity), every Apple-specific magazine (they know where their bread is buffered), and even most general titles (all's fair, of course), the misinformed Mac-owning yuppie will covet *Jazz* badly. If he has a spare $600, he just might succumb to Lotus' promises. And only if he is too dumb to know or too proud to admit it will he not be disappointed.

It is not too late to make the Macintosh into the machine it should have been in the first place.



Author's conception of a Super Mac. Supports 5 Meg of true RAM, 20 Meg hard disk, offers 8.5" x 11" display, and sports an expansion bus.

Most of all, however, I feel badly for the Macintosh itself. *Jazz* was supposed to be the product that would finally catapult the Mac into the business market. When that doesn't happen, Apple will be in a tough position. It has never thought of the Macintosh as a home computer. And yet according to our 1985 survey, an overwhelming majority of our Macintosh-owning readers have the machine at home. As you may also read in this issue, the Atari ST computer does a fine rendition of its own desktop metaphor and much, much more. I hope you caught our Amiga review last month, for that machine also has a brilliant future. The Macintosh, at least in its current form, is therefore headed into dangerous waters—unless it can make the breakthrough that *Jazz* promised but will ultimately fail to make.

This is a crying shame, for though I use the word "great" more carefully than others in the field, I know the Mac is a great computer. Too great, one might imagine. So great it brought out in classic, almost Promethean manner a tragic flaw in the Mac project management team. It is a flaw latent in all men who dabble with greatness: that of *hubris*, which Webster defines as "overbearing presumption."

The Key to Nonsuccess

If there is one thing I have learned in six years of living with microcomputers, it is that machines must be designed to appeal to the lowest common denominator, but only while simultaneously accommodating the highest. If you would aspire to failure, design a machine that is "finished," then close the door to the future. Underestimate the needs and desires of your buyer, as well as his sophistication. Present a market line that forces him into a cubbyhole. Discourage third party manufacturers, and burn your decisions into ROM.

Blue Over Big Beige

For all its greatness, the Mac fell victim to the very hubris I have described. Its floppy drive was designed to thwart known standards, to ensure no clones. Its memory capacity was capped to thwart competition with its now-deceased mother, the Lisa. Its architecture was closed to thwart third party manufacturers in adding hard disk drives and peripheral boards. One exceptionally awful story tells of the incredulity of the Mac team when it learned about the

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Hyperdrive, a 10Mb internal Winchester. "It isn't possible," the story quotes a Mac-designer. "We made sure of it."

In its competition with IBM, Apple had ironically become its own worst enemy. I had at one point actually taken to calling the company "Big Beige."

John Sculley of Apple has recanted this philosophy of closure publicly, and while we have all rejoiced, it is all too easy to lay the problems of the Macintosh at the feet of the exiled king of Apple, Stephen Jobs. Surely he had a hand in it and has at least as much hubris as the next millionaire child prodigy. But the decisions of Apple Macintosh were never his alone; ergo he should not bear the blame alone. He is, however, savvy enough to know the importance of the role of scapegoat, and he wears the label with dignity.

It is time now to lay aside the placing of blame, and get down to the hard work of redressing the errors. If they work quickly and with resolve, it is not too late to make the Macintosh into the machine it should have been in the first place. Neither is it too late to make the Macintosh into a machine in business at home and at home in business. It is utterly crucial, however, that the right decisions be made. Apple has voiced a commitment to redress. It remains to be seen whether they are truly smart enough to know what the right decisions are.

Take, for prime example, the matter of the Color Macintosh. I am of the strong opinion that a Macintosh with a color CRT is absolutely the wrong road to take for it would sacrifice the superlative monochrome resolution that has made the Macintosh what it is. Yes, color is necessary to compete with new generation machines, but replacing the monochrome CRT is not the right way to do it.

Prying Off the Lid

The right way to do it is to provide an expansion bus, as should have been done in the first place, to accommodate any and all manner of hardware peripheral boards. Among these might be an ultra hi-res RGB card, perhaps sporting its own VLSI processor. Want color? Attach a color monitor, and you're off.

Rather than an inboard color CRT, I would much rather see a larger, vertically mounted monochrome tube, allowing you to view an entire 8.5" x 11" page at a time. At that screen size, multiple windows would become truly manageable, and the shackles would come off *MacWrite*, *MacPaint*, and all other truly indispensable software.

Then there is the dual-sided floppy drive. A matter for the circular file, in my humble but vehement opinion. The time and price-point have come to make hard disk drives standard equipment for the Macintosh. And I don't mean serial daisychaining from the modem or printer port, which equates to *a priori* crippling of capability. I mean a parallel driver from the expansion bus. If you own or have seen a Mac running with a Hyperdrive, you know how the Mac ought to run. No one needs an external floppy drive to run *Jazz* or anything else.

Pre-eminent among considerations for an open Macintosh is the overwhelming need for more RAM.

An internal floppy must remain standard only to boot new packages and make data transportable. Otherwise, the machine should run exclusively from hard disk.

A corollary of this specification is the need to run protected software from hard disk. I have argued hard in the past for unprotected Macintosh software and lament to this day the passing of the early, idealistic mentality that was once committed to it. But I understand that it erodes the strength of the third-party community. All I ask is that a protected package be capable of writing itself to hard disk. This is eminently possible, and I believe the approach to be the inescapable future direction of all software. Macintosh developers must, for the good of the machine, commit to it as well.

Pre-eminent among considerations for an open Macintosh is the overwhelming need for more RAM. As I stated in my initial review of the machine, in the dim recesses of July, 1984, the ambition of the Macintosh user interface fairly demands two, three, even six times the memory currently set as a maximum. That Apple ever marketed a 128K Macintosh is further evidence of their failure to comprehend the scope of the machine. That they designed it to top out at 512K is a crime. Its processor can address up to 16Mb of RAM, and Apple must make it possible to address up to 16Mb of RAM, and no less.

Yet with a mere 1Mb, the Mac could run *Write* or *Word*, a power spreadsheet like *Crunch* or *Click-It*, Microsoft *Chart*, *MacTerminal* or *Red Ryder*, and Microsoft *File*, all simultaneously under Switcher, the RAMdisk I describe in the *Jazz* review. With such a configuration, the Macintosh would immediately be propelled into the realm of a muscular, high-powered business machine. Lotus could make the 1Mb version of *Jazz* into a product that was truly worthy of the name Lotus.

With, say, 5Mb, a 20Mb parallel hard disk, and a laser printer, the Macintosh would not only be a formidable business contender, but conceivably the front-runner—if one more early error of hubris is redressed—the forbidding spectre of IBM compatibility.

This is perhaps the bitterest pill for Apple to swallow, in itself representing a surrender to the standard of the major competitor. The arguments against it have validity; why face "the rest of us" with the complexity of cryptic command codes, a mediocre standard, and on and on. But the fact is that IBM owners are among "the rest of us" as well, and if the Macintosh is ever to succeed in the business market, it must invite current IBM owners to upgrade to the "SuperMac" without having to toss their existing datafiles. The easiest way to do this is to open the expansion bus to a coprocessor and a 5.25" IBM-standard floppy drive. The way to beat Big Blue is not to imitate their management inflexibility or market compartmentalization. It is to open the minds of their customers to a choice that tempts rather than antagonizes them. And this calls for the potential to imitate Big Blue's product.

Make Yourself Heard

Do you agree with me and want to lend Apple a helping hand? Photocopy this column, and send it to John Sculley along with your own comments. I invite your comments as well. Write me at the magazine or via CompuServe (76703,654) or MCI (JANDERSON CRE COM). ■

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CIRCLE 124 ON READER SERVICE CARD

True Basic

The creators of Basic show the way/**Glenn A. Hart**

Probably the bitterest debates in computerdom concern languages. Getting IBM PC adherents and serious Apple types together can certainly lead to fireworks (or worse), but for real vitriol try putting a Forth fanatic together with a C devotee, a pistol-packing Pascal virtuoso and a Basic fan. Throw in a Cobol corporation man and maybe an APL freak, and stand back.

Basic is often considered unworthy of serious consideration. The convoluted and difficult to follow code that can result from indiscriminate use of the notorious GOTO command, the lack of branching and looping constructs and procedures popular in structured programming schools, and other weaknesses make most current Basic implementations something of a joke among serious programmers.

Basic was created more than 20 years ago by two Dartmouth professors, John Kemeny and Thomas Kurtz. Since then, their brainchild has become the most commonly used programming language in the world. Now they have teamed up with a group of young whiz kids to produce True Basic, a new programming language which they hope will become the standard dialect of Basic.

True Basic is beautifully packaged, elegantly designed, and easy to use. The True Basic environment splits the screen into two windows, an Editing Window for entering and modifying programs and a History Window for commands and program output.

True Basic programs are written and modified with a full-screen editor which uses cursor control keys and control character sequences. The commands are not totally standard compared with most other PC programs, but they work fine and don't take long to learn. Complete find and replace provisions are included, a major advance over the simple editor provided with Microsoft's BasicA. Blocks of text can be marked and then moved, deleted, indented, edited as a group, etc.

The best feature of the editor is RESTORE, which replaces text after an inadvertent deletion. True Basic restores only while the cursor is positioned on the line where the mistake was made, but it is much better than nothing.

The editor uses function keys to invoke several common commands, and

True Basic graphics are superior in many ways to those in Microsoft Basic.

True Basic also uses function keys to move back and forth between the editing and history windows, run programs, etc. A key redefinition provision allows you to change the key layout and is much more sophisticated than the simple function key redefinitions available in BasicA.

True Basic acts like a Basic interpreter in some respects and like a compiler in others. Like an interpreter, it allows several commands to be issued at the command line (LET, ASK, PRINT, SET, etc.). Variables are "active" after running an "uncompiled" program, so this "direct" mode can be used for debugging by examining the value of variables when a program is interrupted.

Once a program is entered or recalled from disk into the Editing Window, it can be run. If the program is in source form, True Basic first compiles it to an intermediate code and then invokes a special interpreter to execute the code. The semi-compiled code can be saved to disk, in which case True Basic won't have to take the time to perform the compilation the next time that program is called.

The True Basic language itself is modeled on the proposed ANSI standard Basic, which is quite different from the Microsoft Basic which has become a *de facto* standard on microcomputers. Professors Kemeny and Kurtz have written an enjoyable book called *Back to Basic* which discusses the differences. Both the various design decisions that make ANSI/True Basic unique and the Microsoft style, which the authors deplore, are analyzed in complete, if perhaps biased, detail.

True Basic

PERFORMANCE (−) (+)

EASE OF USE (−) (+)

DOCUMENTATION (−) (+)

UTILITY (−) (+)

OVERALL VALUE (−) (+)

System and Price: IBM PC (Macintosh coming soon); $149.90

Summary: Powerful, flexible new direction for Basic language, but will it catch on and become a standard?

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CIRCLE 158 ON READER SERVICE CARD

Adding Structure

The main objective of True Basic is structure, the process by which programs are designed and implemented in a modular manner which improves readability and maintainability. Structured programming has become a basic tenet of computer education, and also allows smoother implementation of large programs. True Basic includes structured programming constructs superior even to those of Pascal or C.

True Basic programs normally do *not* use line numbers; they employ new, improved branching facilities, although line numbers and most of the old style branching statements are allowed. If even one line has line numbers, then *all* lines must be numbered. Routines to add, remove, and renumber lines are included. Various True Basic commands can use line number ranges or block names or a combination of both. Variable names can be up to 31 characters long. LET must be used when values are assigned to variables. Only one statement can be on a line. For the most part, True Basic makes no distinction between integer and floating point numbers, and no trailing symbols are used to indicate numeric precision.

Conditional branching can be performed with either single line simple IF-THEN and IF-THEN-ELSE statements or more complex multiple-line IF-THEN-ELSE-END IF structures. True Basic is reasonably rigid on where clauses go, but improved structure and readability usually result. True Basic also includes a multi-branching switch construct SELECT CASE statement complete with ELSE (like the OTHERWISE clause often used in Pascal). SELECT CASE creates much more readable code than a series of IF-ELSE statements.

True Basic offers an excellent assortment of loop constructs. The FOR-NEXT design is standard, although no potentially confusing fanciness like omitting the variable name after the NEXT or terminating multiple FORs with one NEXT is allowed. The other loop constructs provided are DO UNTIL cond - LOOP, DO - LOOP UNTIL cond, DO WHILE cond - LOOP, and DO - LOOP WHILE cond. The UNTIL-type statements and the WHILE-type statements can perform the same functions (the logic of the condition being tested would simply be reversed), so the choice is a matter of style.

EXIT DO and EXIT FOR statements allow exiting from the middle of a loop to the line immediately following the loop. These statements can result in much more natural code than some of the convoluted constructions sometimes required by "pure" structured methods.

DATA and READ work normally, but with some interesting wrinkles. MORE DATA and END DATA clauses are provided to make reading data easier (e.g., DO WHILE MORE DATA). RESTORE is available, but there is no RESTORE to a specific location or line number.

True Basic arrays must be declared with a DIM statement; there is no default to a ten-element array size. As in Pascal, *both* lower and upper array bounds can be specified, so a statement like DIM X(1980 to 1990) is both descriptive and permitted.

The main objective of True Basic is structure, the process by which programs are designed and implemented in a modular manner which improves readability and maintainability.

Array access is light years ahead of most microcomputer Basics, because a full assortment of MAT statements, which manipulate arrays without cumbersome nested FOR-NEXT loops, are provided. MAT statements have been available on some mini and mainframe Basics, but not normally on microcomputer implementations. True Basic includes MAT READ, MAT PRINT, MAT INPUT, and MAT LINE INPUT statements as well as MAT arithmetic functions.

One of the worst "features" of old Basic is that all variables are global, i.e., accessible to the main program as well as any subroutines. This can lead to all kinds of subtle bugs, artificial constructions, and more. True Basic remedies this situation by allowing subroutines and functions to have parameters. Both single line user-defined functions like those in Microsoft Basic and multi-line functions as in CBasic are allowed. If subroutines and functions are defined prior to the END statement in a program, they are referred to as "internal" routines and their variables are global. The same routines and functions defined *after* the END statement are external, and their variables are local to the subroutine or function. Parameters are passed to functions by value and to subroutines by reference. Both functions and subroutines can be used recursively. True Basic even allows arrays to be passed to both functions and subroutines. External assembly language routines can also be accessed.

Subroutines and functions can be grouped together into external libraries, an advanced feature which can be used for structure or to distribute functional code. True Basic is supplied with four powerful libraries for advanced numeric computations and graphics, and several more libraries are being developed for future distribution.

True Basic string manipulations differ markedly from the Microsoft style. The True Basic string commands are sometimes more readable and sometimes less so, but LEFT$, MID$, RIGHT$, and other familiar functions can easily be programmed if desired.

Graphics and Sound

True Basic graphics are also quite different from and superior in many ways to those in Microsoft Basic. Unlike IBM PC BasicA, which uses coordinates based on the pixels available on the PC screen, True Basic can set any edge coordinates desired and will draw in terms of this view. The commands available cover a wide range of both simple and complex graphics manipulations. In addition to various fast point, line and box drawing routines, True Basic PICTURES are like graphic subroutines and can have parameters for modifications at each call. Five "transformations" are available to slide a picture, change its size, scale, rotate, or lean a picture. True Basic can also establish windows, but these (like the other graphics features) are available only on color systems.

Music and sound are easily created with a PLAY command which uses a very simple and straightforward notation for music, including such niceties as dotting, legato and staccato attack, and more. A more traditional SOUND command is also available for specifying frequency and duration.

Other language features add clarity and simplicity. The True Basic INPUT statement makes operator prompting clear and consistent. A KEY INPUT clause indicates when a key has been pressed for good interactive control. SET CURSOR and ASK CURSOR statements position the cursor, turn it on and off, and query its position. True Basic PRINT US-

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CIRCLE 116 ON READER SERVICE CARD

Table 1. Sieve of Eratosthenes.

True Basic:	1 minute 20 seconds (80 seconds)
Microsoft BasicA Interpreter:	14 minutes 41 seconds (881 seconds)
Microsoft Basic Compiler:	5 seconds

ING facilities are similar to those of Microsoft Basic but with a few differences and advantages. For example, left and right justification and centering are available when strings are formatted. A CHAIN command allows you to run another program, although the ability to pass information to a subsequent program is rather limited. True Basic error handling allows you to "protect" a block of code with an error handling routine. The error handling is more flexible and better structured than in BasicA and most other Basics.

True Basic manipulates three kinds of disk data files. BYTE files have no structure and can be considered as simply streams of bytes that can have any arbitrary, user-defined format. RECORD files are fixed length data files. TEXT files are stored in standard IBM text format for use by any PC application. True Basic RECORD files are portable to *any* computer running True Basic (as are any True Basic Compiled B-Code program files).

File manipulation commands include OPEN (assign a channel to a disk file), CLOSE a channel, ERASE (delete the contents of a file), UNSAVE (delete a file itself), SET file attributes, and ASK to determine the attributes of a file. Ten files can be open simultaneously. Channels can be local or global, much like variables; an external function or subroutine can have its own channels, which close automatically when the routine is exited.

The OPEN statement has clauses to set ACCESS mode, CREATE mode (whether to use an old file or create a new one), ORGANIZATION (the file type: text, record, or byte), and the RECSIZE. The SET command can change the MARGIN (actually its line length), ZONEWIDTH (the tab settings used when commas separate field output), or RECSIZE of a file.

The ASK statement is a powerful command which can determine many attributes of a file, including its access mode, file size, margin, name, organization (type), pointer location (beginning, middle, end, or, alternatively, exact record or byte count), recsize or zonewidth.

Use and Performance

To test the performance of True Basic, I first ran the Sieve of Eratosthenes prime number program at the standard ten iterations and the *Creative Computing* simple numeric benchmark for True Basic, the Microsoft BasicA interpreter, and the Microsoft Basic Compiler. The results of the tests, which were run on an IBM PC AT, appear in Tables 1 and 2.

Both of these benchmarks indicated that the semi-compiled True Basic is significantly faster than the BasicA interpreter—perhaps ten times as fast and with better accuracy. On the other hand, True Basic is simply no match for a good native code compiler like Microsoft's Basic compiler.

I then translated the disk drive testing benchmark developed by Mike O'Cone of *PC* magazine. While this is normally used to test computer/drive performance, I felt it could shed some light on disk access differences between languages. This guess was confirmed, because the differences were dramatic. Using 128K sectors and writing and reading randomly and sequentially a 200K data file created on a RAM disk to eliminate mechanical factors, I got the results shown in Table 3.

The developers of True Basic informed me that many sections of True Basic are written in True Basic itself, which helps portability at the possible expense of speed. It appears that I hit a nerve with the disk access routines, which clearly should be rewritten in assembly for better performance.

The translation process was informative in itself. The editor is easy to use and reasonably flexible, although I wish it retained indentation on subsequent lines as the Turbo Pascal editor does. When an attempt is made to compile and run the program, True Basic positions the cursor at the exact location of an error and displays an English error message. This is an excellent feature, which

Table 2. Ahl Benchmark.

	Accuracy	Random	Time
True Basic:	9.33869E-9	.3871	6.9 seconds
Microsoft BasicA Interpreter:	1.159668E-02	9.317505	9 seconds
Microsoft Basic Compiler:	1.153564E-02	20.39172	1 - 2 seconds

Table 3. Disk drive benchmark.

True Basic:	3 minutes 41 seconds
Microsoft BasicA Interpreter:	2 minutes 48 seconds
Microsoft Basic Compiler:	1 minute 13 seconds

greatly eases accurate program entry and development. On the other hand, the program cannot be run at all until *all* errors are removed.

True Basic includes a BREAK-CONTINUE mechanism as a debugging aid, but the debugging tools are *not* as powerful as those of Morgan Professional Basic and some other advanced BasicA utilities. Unfortunately, the TRACE facility standard with Microsoft Basics is lacking in True Basic. Overall, the debugging assistance must be classified as fair at best.

The syntax differences between Microsoft BasicA and True Basic were not as bad as I had expected. The True Basic file syntax is much better than Microsoft's, but the language design is still not as clean in this regard as CBasic. A programmer should not have to count field locations—this is the kind of thing a computer does well. The authors of True Basic blame this on the deficient ANSI standard, but perhaps they should simply bite the bullet and design their own procedure.

Because True Basic program files are straight ASCII, *WordStar* and/or a keyboard macro program like *Prokey* or *SuperKey* could be programmed to help semi-automate conversions. The True Basic team is working on a conversion assistance product, which we will review when it is released.

I was excited by the character by character access which byte files allow. Previously, a Basic programmer had to LINE INPUT a line of text and then use MID$ to work with individual characters. To test byte access I wrote a program that converts *WordStar* files to standard DOS files. The program worked the first time, but was definitely on the slow side. It proved to be faster to use the older technique and use the True Basic line$[i:i] (like MID$ in BasicA) for the strip.

I also tested the Binder which allows commercial software houses to produce stand-alone executable files. The binding process itself was quick and painless, *but* a 44-byte source file (to issue a formfeed to the line printer) became a 63,622-byte .EXE file. Microsoft's BASCOM created a stand-alone executable file which performed the same function in 17,792 bytes. A True Basic executable version of the Sieve took 63,898 bytes, so obviously the run-time interpreter takes up 63,000 bytes or so. I have heard of overhead, but this is ridiculous!

As comprehensive as True Basic is, there are also some reasonably serious omissions too. As mentioned, the True Basic RECORD file is really a string file system, so the file system is awkward.

Microsoft Basic has been around so long in its various dialects that it forms a tremendously powerful de facto standard.

True Basic does *not* support communications ports, because "After all, True Basic is designed to be identical on every computer, and communications ports are quite different among various computers." The manual suggests using assembly language, which is way beyond most users. The developers of True Basic indicated to me that this flaw would be rectified in a future library. Similarly, there are no hex number facilities or DOS access routines; these are being rectified in libraries as well. The mouse facilities were left out of the IBM version, but evidently will be added later, etc. The language system would benefit greatly by the addition of a fast native code compiler.

The documentation is simply superb. Two manuals, totaling over 600 pages, are provided. The True Basic User's Guide is an excellent introduction to the language and its use. Each chapter begins with a statement of goals and a glossary of the terms introduced and ends with a succinct summary. The writing is clear, easy to understand, and never condescending, and provides a fine tutorial on Basic itself as well as the True Basic dialect. The Reference Manual is equally good, and both documents include a detailed and usable Index.

A New Standard

The True Basic team asserts that the "American National Standard for Basic will be the standard form for Basic for years to come." This is quite a conjecture for a standard that hasn't even been officially released. They hope that the language's portability, use of the full IBM PC memory space rather than the limited memory model used by Microsoft, use of the 8087/80287 math coprocessor if present, the context sensitive on-line help system, the comprehensive editor, etc. will be important factors.

The main problem is that Microsoft Basic has been around so long in its various dialects that it forms a tremendously powerful *de facto* standard. Microsoft is an entrenched competitor that will be exceedingly difficult to unseat. Add to this the fact that while the True Basic price of $150 is exceedingly reasonable, BasicA on the IBM PC is *free*. Neither is there any law forbidding Microsoft to change and improve. Their new Basic for the Apple Macintosh (see *Creative Computing*, May 1985) is exploring some of the same approaches used by True Basic. If Microsoft decides to issue an ANSI standard Basic in the future, True Basic could be in trouble.

True Basic is unquestionably an excellent language. It is powerful, friendly, and easy to use. If someone could wave a magic wand and replace every copy of a Microsoft Basic of one sort or another with a copy of True Basic, I think the computing world would be a far better place. Whether the True Basic team, even with famous heavyweights like Kemeny and Kurtz involved, has the clout to unseat the current champion remains to be seen. ■

Discovery Software

An educational giant makes a big splash in the software pool/**Betsy Staples**

When I was a child, my parents were strict about eating meals together at the dining room table. On those occasions when my parents were not at home, however, we children were accorded the great treat of eating in the family room. At those times, I always reached for a volume of the *World Book Encyclopedia* and spent my solitary meal perusing the pages and assimilating painlessly all sorts of useful and not so useful information.

Imagine, then, my delight at discovering an entire new line of educational software from my old friends at World Book.

Discovery Software sets new standards for consistency and continuity in a line of educational software. The professional educators at World Book spent four years analyzing the areas in which children need the most help and incorporating their more than 60 years of experience into a software series that addresses those needs in a thoroughly competent and beguiling manner.

The sturdily boxed packages come in sets of seven programs for each of three age levels: preschool (ages 3 to 5), primary (ages 6 to 10), and intermediate (age 10 and up). The format of the individual programs and the controls for moving about within the programs are totally consistent within a given level. In the primary set, for example, each program begins by asking the child "Do you want sound?" He makes either the YES or NO flash by pressing the spacebar. When the appropriate word is flashing, he presses ENTER to register his choice.

The preliminaries out of the way, he sees a menu that represents graphically all the games on the disk. Again, he chooses, using a combination of spacebar and ENTER. At any point, he can return to the picture menu by pressing ESC. The other levels are similarly consistent with increasingly complex commands and controls.

The preschool level packages feature between six and eight different games each. Most of the packages in the primary level offer between one and four activities, with those that have only one basic activity offering multiple difficulty levels. The intermediate level packages typically consist of one basic activity, ranging from arithmetic practice to a simulation of life in early America. Some also feature review sections and/or multiple difficulty levels.

Discovery Software

DOCUMENTATION	(–) (+)
PEDAGOGY	(–) (+)
EASE OF USE	(–) (+)
EXECUTION	(–) (+)
GRAPHICS	(–) (+)

System and Price: IBM PCjr, Apple II, Tandy 1000; $39.95 each, $249.95 set of 7

Summary: Outstanding collection of educational software—competent, consistent, and entertaining

Manufacturer: World Book Discovery 5700 Lombardo Centre Seven Hills, OH 44131 (216) 642-3900

CIRCLE **408** ON READER SERVICE CARD

Outstanding Documentation

The documentation for the entire series is exemplary. Each package comes with a 24-page User's Information and Activity Guide, which begins with a note to grown-ups, parents, or users (depending on the age level) and instructions for getting started. After the first game, however, our playtesters never needed to refer to those instructions; the consistency and simplicity of the activities made it possible for them to figure out what they needed to know very quickly.

Four-year-old Margie Koppin, having learned to type AUTOEXEC on the PCjr, enjoys learning with her friend Pockets and Discovery Software.

The remaining pages of each Guide are, perhaps, the most valuable part of the package; they describe non-computer activities and projects the child can do to augment his understanding of the concepts practiced on the computer. These activities complement the programs and provide expert guidance for parents and teachers. And World Book even provides an educational objective for each section.

Preschool Level

The preschool level features Pockets, a kangaroo in basketball sneakers.

Packages in this set include: *Come Play with Pockets*, which offers practice of visual memory skills; *Pockets Goes on Vacation*, which offers practice in identifying positional relationships; *Happy Birthday, Pockets*, which offers practice in visual discrimination; *Pockets Leads the Parade*, which offers practice in pattern recognition; *Pockets Goes to the Carnival*, which offers practice in one-to-one correspondence and counting; *Pockets Goes on a Picnic*, which offers practice in making associations; and *Pockets and her New Sneakers*, in which Pockets abandons her basketball sneakers to provide practice in classification by color, shape, and size.

The games in this set are very simple, but even after many hours of play, our playtesters still show no signs of boredom.

Primary Level

The programs in the primary level set offer practice in a wide range of skills: *Mighty Math* features review of basic arithmetic skills at varying levels of difficulty. *Space Port* features practice of vi-

sual memory skills at varying levels of difficulty. *Word Player* features practice in vocabulary building and offers a create-your-own-stories option. *How Things Work* features review of how tools can be used to make work easier. *Take Me North* features practice in using cardinal directions, and in using map reading skills. *A-mazing Words* features spelling review at varying levels of difficulty, "beginning at the primary grades and useful through high school." And *Plot-a-Point* features practice in the use of number lines and the plotting of coordinates.

The only gaffe we noted in the Discovery Software series appeared in *How Things Work*. In this game, the child must choose which of three basic tools will solve a problem pictured on the screen. The fourth option is a box filled with question marks. If the child selects the question marks, he is returned to the "information section where he can find out more about machines." Unfortunately, he is not allowed to return to the problem to test his knowledge. Our playtesters found this frustrating.

Intermediate Level

Again, the range of skills and difficulty is wide, and I found myself fascinated by some of the activities—especially in *Run for President*, a social studies program featuring review of geography facts about the U.S. and review of U.S. state facts, and *Settling America*, a simulation featuring practice in decision-making and review of facts about everyday life in early America.

Other programs in the set include: *WhizCalc I*, an arithmetic skills program featuring practice of basic arithmetic operations with nine levels of difficulty; *WhizCalc II*, an arithmetic comprehension program featuring practice in solving arithmetic word problems and exposure to a junior spreadsheet; *Spellbound*, a critical thinking skills review program featuring verbal analogies and four levels of difficulty; *Fast Break*, a punctuation skills review program featuring explanation of commonly used punctuation marks and practice in using punctuation marks in context; and *Data Hurdles*, a data use skills review program featuring three levels of difficulty, ten data manipulation skill segments, and on-screen tutorial skill reviews.

Summary

The only thing that really bothered me about the Discovery Software series is, unfortunately, a characteristic of the only machine on which the software currently runs. The process of copying DOS onto the program disk using the single-drive of the PCjr can only be described as torture. I did, however, discover that a four-year-old can be taught to load DOS separately and type AUTOEXEC.

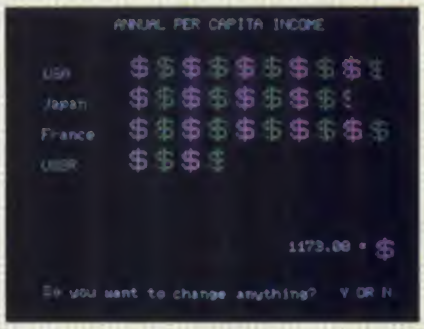
It is obvious that the people at World Book invested a great deal of time and effort in their Discovery Software. The programs are well thought out, competently executed, and pedagogically sound.

Choose the one that reviews an area in which your child needs practice, or buy the whole set—you won't go wrong with software from one of the best known names in American education. ■

SOFTWARE COMMENTARY

A discriminating selection of current releases

Easy Graph



(–) (+) PERFORMANCE

(–) (+) EASE OF USE

(–) (+) DOCUMENTATION

(–) (+) UTILITY

(–) (+) OVERALL VALUE

System and Price: 64K Apple II disk system, IBM PC/PCjr, C64; $39.95

Summary: A nice introduction to graphing, but of limited usefulness

Manufacturer: Grolier Electronic Publishing, Inc. Sherman Turnpike Danbury, CT 06816 (800) 858-8858

CIRCLE **409** ON READER SERVICE CARD

Easy Graph from Grolier Electronic Publishing is a well-polished introduction to computerized graphing concepts, yet its usefulness in real-life applications is severely limited. Designed for users aged 8 to adult, *Easy Graph* explains the use and construction of bar graphs, pictographs, and pie charts through a series of menu-driven examples.

With its simple explanations and excellent error-trapping, *Easy Graph* is a valuable tool for youngsters learning the fundamentals of graphs. There is no need to memorize complex commands or worry about axis or scaling—you simply enter the words and the values associated to them (i.e. Neil's Age . . . 21). Once the data are entered, *Easy Graph* takes care of the rest.

Unfortunately, *Easy Graph* can handle only six to eight sets of values, depending upon which type of graph you want. It is not difficult to imagine how this restricts the usefulness of the program. It is, however, impossible for me to imagine an adult actually using *Easy Graph* for many real world business or mathematical applications.

Easy Graph operates on any Apple II with a minimum of 64K and one disk drive. The only way to save information you may have entered is to print the graph, which requires you to have an Epson dot matrix printer. Apple IIc owners must specify the IIc version of *Easy Graph* if hardcopy output is desired. *—OWL*

Road Rally U.S.A.

(–) (+) GRAPHICS

(–) (+) PLAYABILITY

(–) (+) EDUCATIONAL VALUE

(–) (+) DOCUMENTATION

(–) (+) EASE OF LEARNING

System and Price: IBM PC with color graphics adapter, PCjr; $39.95

Summary: Lots of geography fun and learning in an attractive package

Manufacturer: Bantam Electronic Publishing 666 Fifth Ave. New York, NY 10103 (212) 765-6500

CIRCLE **410** ON READER SERVICE CARD

A relative newcomer to the educational software community, Bantam Electronic Publishing should make a big splash with its entertaining educational programs for elementary age children. One of the best is *Road Rally U.S.A.*, a program that puts you in the driver's seat, requiring you to use your knowledge of history and geography to find key locations and earn points.

At the lowest of three difficulty levels, you are told simply to go to a given location—usually a city. At the highest level, you receive more subtle clues and challenging clues: "Make tracks for the MD site of the first Railroad" (Baltimore).

Once you have identified your destination, you consult the map card for the region (New England, Mid Atlantic, Southeast, North Central, South Central, Northwest, or Southwest) you have chosen and drive there. The highways, cities, and points of interest represented on the map are real, and children especially enjoy driving to and through places they have visited.

To add a bit more challenge to the game, Bantam has included assorted hazards (bad weather, landslides, careless drivers) and limitations. The radio on your dashboard (represented at the side of the screen) warns you of some hazards, but if you fail to heed its warning and collide with a truck or a fallen tree, you lose one of the three cars with which you start each round. The limitations, time and fuel, are easier to cope with. Twelve minutes is usually plenty of time for all but the youngest players to find the three to five required locations, and if you run low on gas, you have only to stop at a gas pump to fill up.

Road Rally U.S.A. is loads of fun for the whole family—the sort of game that can be enjoyed by a group of friends, even though only one actually drives the car. The controls are simple enough for young players to master, and the more difficult questions are challenging enough for adults to enjoy. *—EBS*

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CIRCLE 133 ON READER SERVICE CARD

Smoothtalker

(–) (+) **PERFORMANCE**

(–) (+) **EASE OF USE**

(–) (+) **DOCUMENTATION**

(–) (+) **UTILITY**

(–) (+) **OVERALL VALUE**

System and Price: Macintosh; $149.95

Summary: Competent speech synthesizer that needs no additional hardware

Manufacturer:
First Byte, Inc.
2845 Temple Ave.
Long Beach, CA 90806
(213) 595-7006

CIRCLE 411 ON READER SERVICE CARD

Smoothtalker for the Macintosh uses what its manufacturer calls Multiple Pole Analysis to create speech. This flexible proprietary technique is theoretically capable of articulating any word in any language—without precoding or ROM storage.

The package consists of two main software components. The front end translates the English input text into 41 phonetic codes, using more than 1000 characteristics of the English language. The encoded phonemes are then fed to the back end, which tells the Mac to generate the sounds of speech. The phonetic codes can be entered directly as well, which is useful for tweaking the accuracy of the output.

Smoothtalker incorporates a lookup dictionary of oddly pronounced words, abbreviations, and other exceptions, to which you can add your own entries. Input is accepted directly from the keyboard, from an included text editor, from a *MacWrite* or Microsoft *Word* document that has been saved in Text mode, from the contents of the clipboard or scrapbook, or from "certain programming languages," including Basic 2.0, Pascal, C, Forth, and assembly.

Once input text is available, you can adjust volume, pitch, speed, tone (bass or treble), and voice (male or female). These adjustments can be applied to the entire document or to only a specified portion. Instructions can be imbedded in the text.

It is not at all necessary to know or learn the phonetic codes to use *Smoothtalker*, but they are useful for optimizing pronunciation of tricky words or for improving the inflection of generated speech. In general, the speech is clear, and I find it easy to understand, especially if the Mac is attached to an external sound system.

How can the system be used? Presi-

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CIRCLE 134 ON READER SERVICE CARD

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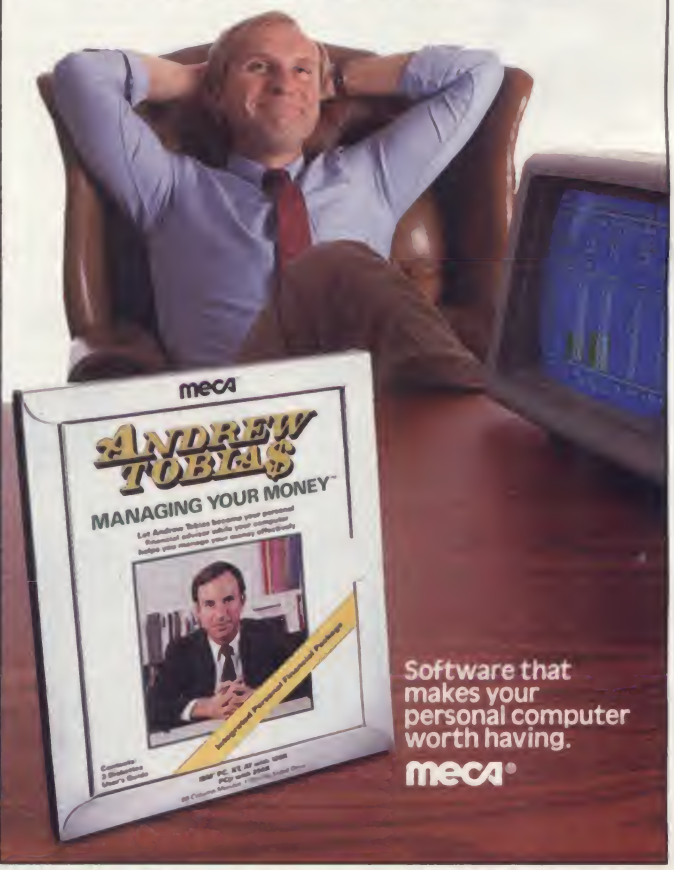

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dent David Fradin of First Byte says that current uses include reading text to the handicapped, education, and proofreading. I can think of dozens of uses just within those categories, and I am sure that imaginative users are already discovering additional applications.

All in all, I would categorize the performance of *Smoothtalker* as good. It seems fairly priced, and if one of the suggested uses fits your needs, it can be a bargain—perhaps even a godsend. If not, it is still tremendous fun.

—Glenn Hart

Financial Time Machine

EXECUTION (–) (+)

PLAYABILITY (–) (+)

CHALLENGE (–) (+)

ADDICTIVENESS (–) (+)

EASE OF LEARNING (–) (+)

System and Price: IBM PC, PCjr, C64; $59.95

Summary: Fascinating model of investment world from 1930 to present

Manufacturer: Insight/Lehner Communications 2708 Arlington Highland Park, IL 60035 (312) 432-5458

CIRCLE 412 ON READER SERVICE CARD

Financial Time Machine is an accurate computer model (in game form) of the real investment world from 1930 through 1984. With it you can explore how 32 widely varied investments were affected by peace, tension, war, depression, inflation, recession, and recovery.

The game can be played by from one to four players. You select the starting year of a five-year period and you are off and running. Across the top of the screen runs a ticker tape which displays current prices of the 27 stocks and five other investments. Just under it is a news wire which displays investment, political, and even entertainment and sports news. The main part of the screen displays the investment portfolios of the individual players (one at a time). As the quarter progresses, players can make investment decisions. Although you have the sense of playing the game in real time because both tickers keep moving by, each quarter takes about six minutes, so there is plenty of time for players to make their decisions. Indeed, with just one player, time seems to drag a bit. An entire five-year game takes about two hours, although you can save a game in progress at the end of each year (every 24 minutes).

The game can be as simple or complicated as you want. You can buy and sell any of 27 stocks, an index mutual fund, gold, bonds, or T-bills. More advanced players can buy on margin, issue limit orders, and place put and call options.

The brief ten-page instruction manual tells you all you need to know to run the model, provides capsule descriptions of each stock, and shows the sensitivity of each stock to the GNP, prime rate, and political factors.

I used the model with a starting year of 1939 and, with 20/20 hindsight, bought stocks of companies like GM, GE, and McDonnell Douglas. I watched the value of my initial $100,000 portfolio soar to over $158,000 by the third quarter of 1940 and then plummet to the $120,00 range when Roosevelt proposed an excess profits tax and the threat of U.S. involvement in the war became more real.

In addition to playing the game over the past 55 years, you can also play it into the future. Imagine my surprise when I saw that the Cubs won five straight World Series, that Iceland was threatening to invade Canada, and that Russia tracked an alien spacecraft near Venus.

For added realism, the program figures in brokerage commissions, margin interest, and taxes. Incidentally, it assumes you are in the 50% tax bracket; perhaps if you play this game long enough, you will be. I felt the game was realistic, accurate, and downright fascinating—recommended! *—DHA*

Local Area

TYING COMPUTERS TOGETHER:

Around the turn of the decade, the corporate world discovered the microcomputer. Emerging from a tradition of mainframe and minicomputer terminals, executives found that pairing this small, relatively inexpensive, stand-alone unit with a spreadsheet offered ease of use, convenience, and increased individual productivity. With the entry of venerable IBM into the market, they accelerated into the Information Age, expanding into word processing, databases, business graphics, and other software to boost the capabilities of their one-stop, desktop information centers.

However, information must be disseminated to be truly effective. A typical business report often requires the skills and data of many people. The problem is to connect these separate microcomputers together to share data. The solution proves to be the local area network (LAN).

An LAN is a collection of microcomputers and peripherals linked by a short-range, common communications path. It allows users to share files such as databases and spreadsheets and provides a cost effective method for sharing expensive peripherals such as hard disk drives and laser printers.

Boundaries of the LAN

Do not confuse LANs with multiuser systems. The distinction between the two is small, yet important. An LAN is a system that ties otherwise independent microcomputers together. A multiuser system uses a time-sharing scheme to link terminals. Once the exclusive province of mainframes and minicomputers, multiuser systems are fast being challenged by powerful microcomputers like the IBM PC AT, Tandy Model 16, and AT&T 3B2 series.

In general, if a microcomputer (or workstation if you prefer mainframe terminology) executes programs with its own processor and in its own memory, it is part of an LAN. If a workstation uses only the processor and memory of a central computer, it is part of a multiuser system. In some cases, a microcomputer-based multiuser system can be more effective than an LAN. However, for overall flexibility, expandability, and performance, an LAN is preferable.

Private Branch Exchange (PBX) systems are often considered and used as LANs. They fit, albeit rather loosely, within the category of linking individual and independent processors and memory. However, PBXs are primarily phone systems that connect microcomputers via modems (see the May 1985 *Creative Computing* for an in-depth look at modems). Wiring costs are extremely low, for you are transmitting over phone wires that are already in place. It is terrific for voice mail—integrating voice with data—but sharing the interoffice telephone system with data-sending computers can cause problems. Reliability is the most critical factor in evaluating PBXs.

Transmission speed, even using special modems, is limited to around 64,000 bits per second (bps), although some PBXs allow up to 128,000 bps. By comparison, the AppleTalk LAN operates at 230,400 bps, and the IBM PC Network, at 2 million bps. The 3Com Ethernet series offers speeds up to 10 million bps. While the cost of installing a PBX is lower, an LAN generally offers superior performance.

Sharing Information and Equipment to Boost Productivity

Networks

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Russ Lockwood

The Year of the LAN

LANs are not a new development. Xerox developed Ethernet at its Palo Alto Research Center back in 1976 to link several single-user minicomputers. However, the early LANs were quite similar to the early microcomputers: expensive, technically complicated, and requiring specialists to install and maintain. As the concept and the systems evolved, LANs became less expensive, yet higher in quality; more flexible, yet easier to install; and more sophisticated, yet easier to use. And like the microcomputer market in general, LANs attracted the eye of industry giants.

Indeed, 1985 may well be remembered as the year of the LAN. Industry giants IBM and Apple, as well as aspiring giant AT&T, all introduced LANs this year. Meanwhile, the smaller, established LAN manufacturers are scrambling to make their systems compatible, especially with the IBM network.

Local area networking is still a fragmented field. According to Dataquest, a San Jose, CA, market research company, industry leaders 3Com and Corvus installed roughly 10,000 LANs each, connecting a total of about 150,000 microcomputers. Apple's much ballyhooed AppleTalk LAN, the Macintosh Office, is installed at 2500 sites linking approximately 7500 Macintoshes. Networked microcomputers, however, still represent a small percentage of the machines sold.

The lack of a true industry standard is keeping many corporations from installing LANs. However, several analysts are predicting that the entrance of IBM into the market with its IBM PC Network Program may help set an LAN standard just as IBM set an operating system standard with PC/MS-DOS.

Already, Microsoft has entered into agreements with 3Com and Ungermann-Bass that will make those two companies' products (EtherSeries and Net/One, respectively) compatible with the IBM PC Network.

Whether IBM sets a standard and dominates the market remains to be seen, but analysts do agree that the LAN market will experience tremendous growth. A Yankee Group study shows that 625,000 microcomputers were connected to one type of LAN or another in 1984. The company expects that number to grow to 7.7 million networked microcomputers in 1988. Dataquest predicts a 46% compounded annual growth rate for LANs and LAN products through 1988, which translates into roughly 7.1 million networked microcomputers.

Hardware LANmarks

In its simplest form, an LAN is a group of microcomputers or workstations connected by cables. The more sophisticated LANs include various peripherals, interconnections with other networks, and a host of specialized components. However, no matter how complex the LAN, it boils down to individual components performing specialized functions.

The term "server" is defined as a component that handles special tasks within an LAN. It can be either a microcomputer or a peripheral, and it caters to all the requests of the networked microcomputers.

A disk server is a hard disk drive that is available to all networked computers. Usually, it is partitioned so that each computer accesses a particular private storage area. For all intents and purposes, it acts like an extra disk drive.

Some disk servers allow certain storage areas, dubbed *public volumes*, to be accessed by all workstations. In many cases, access to a particular file is limited to one workstation at a time. Depending on the LAN and the sensitivity of the data, changing the information in public

Photography by Jeff MacWright.

LANguage

A LOCAL AREA NETWORKING GLOSSARY

Baseband: Transmission method without modulation. The signals take up the entire bandwidth (all frequencies) of the media.

Bps: Bits per second. A measurement of transmission speed.

Bridge: A connection between two similar networks.

Broadband: Transmission method with modulation. The signals can be separated into different frequencies; hence voice, data, and video can be transmitted over the same media.

Bus: A network topology in which all connections branch out from one central line. All signals are available to each station.

CSMA: Carrier Sense Multiple Access. A transmission protocol that requires each workstation to check and make sure that no other station is transmitting data. If two stations transmit data simultaneously, the data will be distorted.

CSMA/CA: Carrier Sense Multiple Access/Collision Avoidance. The same as CSMA except a station will retransmit data when it does not receive confirmation that the data arrived intact.

CSMA/CD: Carrier Sense Multiple Access/Collision Detection. The same as CSMA/CA except stations stop transmitting data if two stations start sending data simultaneously. Each station waits a variable amount of time before retransmitting the data.

Coaxial cable: A medium consisting of a central, insulated wire surrounded by a concentric metal sheath.

Fiber Optics: A medium consisting of glass fibers. Electrical signals are converted into light pulses, transmitted through the fibers, and converted back into electrical signals.

Gateway: A connection between two dissimilar networks.

Infrared: A new medium that sends signals via infrared radiation.

ISO: International Standards Organization. It devised the OSI LAN standard.

LAN: Local Area Network. A collection of microcomputers and peripherals linked by a short-range, common communications path. It allows users to share files such as databases and spreadsheets and provides a cost effective method for sharing expensive peripherals such as hard disk drives and laser printers.

Media: The physical pathways of an LAN over which the signals travel.

Node: A connection on the LAN that can be a microcomputer, server, or network switching device.

OSI: A standard developed by the ISO that divides network functions into seven layers.

PBX: Private Branch Exchange. Essentially the interoffice telephone system. Often used as an inexpensive LAN.

Ring: A network topology that arranges all connections in a circle. All signals pass through each station on the network in turn.

Server: A component, either a microcomputer or a peripheral, that handles special tasks within an LAN.

Star: A network topology that connects all stations to a central server. All signals pass through the central server.

Topology: The layout of the LAN, which determines the flow of signals throughout the LAN.

Twisted-pair wires: A medium consisting of two intertwined copper wires.

Workstation: A microcomputer on an LAN (in mainframe speak).

volumes can be performed by any network user or be restricted to authorized network supervisors.

A file server is a more sophisticated version of a disk server. The hardware remains much the same, except greater software control over the hard disk drive allows access to data by file name. The partitions may or may not be emplaced, and the software provides several layers of security to protect the integrity of the data. In more sophisticated LANs, two people at two separate workstations can access a file and update it interactively.

Disk and file servers can be either dedicated or non-dedicated. If dedicated, the server processes only network operations and is not used as a workstation. A non-dedicated server performs double duty: it processes network operations and offers the option of running applications like any other networked microcomputer. Since non-dedicated servers divide their microprocessing power with stand-alone applications, dedicated servers often perform network operations faster than non-dedicated servers.

Within a network, disk and file servers can be designated as centralized or distributed. A centralized server is like a mainframe setup: all cables, connections, and data lead directly to a single server. It generally handles many network requests simultaneously and offers increased security. The disadvantage of a centralized server is that if it becomes inoperative, the entire LAN goes down. Also, should the hard disk drive be damaged without adequate backup, all files could be irretrievably lost.

Distributed servers make all networked microcomputers equal, allowing all workstations to function as disk or file servers. This type of network is more expensive, since each workstation is equipped with a server, however, loss of one server and workstation will not affect the rest of the network. Security may pose a greater problem in a distributed server network than in a centralized server network.

Key Components: Boards

Just about every LAN requires you to insert an expansion board inside your computer to connect to the network. The boards usually contain a microprocessor, a signal converter, and a network interface controller. In the case of the IBM PC Network, the Network Adapters include an Intel 80188 microprocessor, Intel 82586 communications controller with modem, and Sytek serial

interface controller.

The major exception to this expansion board requirement is the Macintosh on the AppleTalk network. Cables hook directly into the serial port because Apple has included networking circuitry inside the Macintosh.

Some companies, notably The Software Link of Atlanta, GA, avoid boards by using the RS-232C port for networking communications. Its *LANlink* program places the logic that normally resides on the controller chip onto a disk and also in the server. The advantage, according to Gary Robertson, director of marketing for The Software Link, is shorter installation time and lower overall cost.

The "local" in LAN refers to geography. Unlike nationwide computer networks like Tymnet and Telenet, LANs are usually limited to a single building. However, networking distance can be stretched to connect to outside networks with various hardware components.

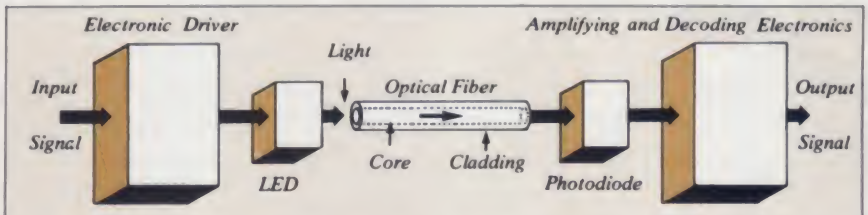
A *repeater* acts like an amplifier and retransmits signals down the line. A *bridge* also retransmits signals, but usually between two different LANs. A *router* is a more sophisticated signal retransmitter that takes longer to forward signals between LANs than a bridge, but determines where messages should be forwarded. A *gateway* connects networks that use different protocols and may also connect an LAN to a mainframe.

Media: The Aisles of LAN

In LAN lingo, the electronic pathways connecting the various components are called *media*. In most cases, the connections are made with twisted-pair wires or coaxial cable, although fiber optic technology is quickly encroaching on the traditional media, and infrared technology looms on the horizon.

Twisted-pair wires consist of two insulated and shielded copper wires wrapped around each other. They are much like telephone wires and carry both voice and data. Indeed, both AT&T and Apple use twisted-pair wiring for their respective StarLAN and AppleTalk LANs. This flexible wire is by far the easiest to install, move, and expand, and it costs much less than coaxial cable and fiber optics.

On the negative side, signals traveling through twisted-pair wires lose power with distance unless extended with repeaters. Signals maintain a reliable speed of up to only 1 million bps. Twisted-pair wiring is extremely susceptible to electromagnetic interference and radio frequency interference (EMI/RFI) and offers poor security unless installed within a specially protected (expensive) enclosure.



In a simple fiber optic setup, a signal from the microcomputer is sent to the driver (sometimes called a converter), which transforms the signal into light pulses. For short transmission distances, a light emitting diode sends the pulses into the optical fibers. For long distance transmission, a semiconductor diode laser is used.

The optical fiber is made of glass and consists of two parts. The core serves as the conduit for the light pulses. The cladding, the opaque portion of the fiber, surrounds the core and prevents pulses from escaping.

At the receiving end, the light pulses strike a semiconductor photodiode. A decoder translates the pulses back into electrical signals, and an amplifier boosts the signal into the microcomputer.

Coaxial cables are the same as those used by cable TV stations. An outer insulating layer surrounds a metallic sheath. Inside the sheath is an inner insulating layer that encloses a thick central wire. The sheath and central wire share the same curvature, hence the term coaxial cable.

Three types of coaxial cable are used: trunk, a high quality cable for long stretches; feeder, to come close to the microcomputer; and drop, the smallest and most flexible cable that hooks directly to the microcomputer. You might think of the cables as roads—trunks are county highways, feeders are residential roads, and drop cables are driveways. Any medium beyond the gateway is an interstate.

Coaxial cable costs more than twisted pair wiring, and installation is more difficult because of the relative inflexibility of the cable. However, coaxial cables allow signals to travel faster, provide greater resistance to EMI/RFI noise than twisted pair wiring, and can carry video signals in addition to data and voice. The IBM PC Network uses coaxial cable.

Fiber optics is a relatively new, yet promising technology for LAN media. While a twisted pair wire or coaxial cable LAN sends signals by shooting electrons along a wire, a fiber optic system changes electrical signals into pulses of light and transmits them along hair-thin lengths of glass.

AT&T, ITT, Corning Glass, GTE, and NEC all manufacture optical fibers. In essence, the manufacturing process involves withdrawing hair-thin fibers from a glass tube. A gas torch deposits various chemicals on the glass and alters the refractive index of the glass.

The resulting fiber consists of two parts: the *core*, which passes the light pulses (signals) along, and the *cladding*, an opaque layer surrounding the core, which prevents light from escaping.

The Telecommunications Products Division of Corning Glass Works displays a working fiber optic LAN at its Corning, NY, office. It connects about 30 DEC Rainbows and a handful of IBM PCs to a DEC VAX superminicomputer. It is not a commercial product, but a showpiece of fiber optic technology. See the sidebar for a sample fiber optic connection.

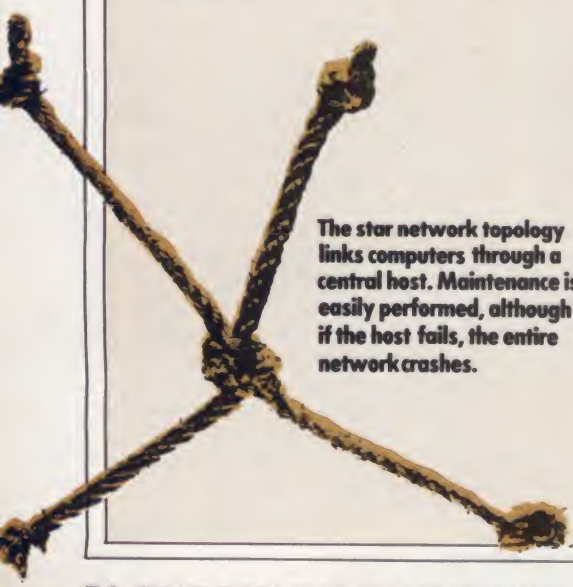
On a more practical front, companies like Ungermann-Bass of Santa Clara, CA; Siecor Fiberlan of Research Triangle Park, NC; Fibercom of Roanoke, VA; and Codenoll Technology of Yonkers, NY, are already marketing fiber optic components for LANs.

Unfortunately, fiber optics is such a new technology, the industry lacks a broad base of skilled technicians. The cost is much higher than either twisted pair or coaxial systems and optical fibers are generally point to point connections; they cannot be tapped into easily for expansion. Also, the capacity of a fiber optic system, at 3 billion bits per second, versus the transmission speed of a microcomputer, even at 19,200 bits per second, represents quite a bit of overkill.

On the other hand, fiber optic systems are virtually immune to EMI/RFI

The ring network topology consists of a circle of microcomputers and peripherals. It offers a faster response time than bus or star topologies, but is difficult to service and expand.

The bus network topology connects workstations to a single, central cable. Stations are easily added and a defective one generally does not shut down the network.



The star network topology links computers through a central host. Maintenance is easily performed, although if the host fails, the entire network crashes.

and serve best in a heavy industrial area. The speed of light is certainly a fast enough transmission speed, and signals remain strong over long distances. Optical fibers are thin and lightweight, provide high data security, and pose no fire hazard.

Still in its infancy, *infrared technology* may help end the cable clutter of LANs. Several companies are exploring this area. Becos Industries of Campbell, CA, has developed an infrared communications device that attaches to an RS-232 port. It permits up to 99 channels of simultaneous communication at a data transmission speed of 400,000 bps.

American Band Stand

In the LAN world, the debate over whether to use baseband or broadband media is as hot as whether Lite Beer from Miller is less filling or tastes great—and as important. To the end user, it matters little. To the technical wizards, it matters a lot.

In *baseband*, one signal occupies the transmission media, and all terminals receive the same frequency. In *broadband*, signals can be divided into different frequencies, so many signals can occupy the medium at once. Like a radio, you can tune into a specific frequency, in effect creating a mini-network within an LAN. While broadband requires more electronics, it also can transmit TV, security, and other signals.

The drawback is that broadband cables are usually unidirectional, which means you need two cables to connect each station. New techniques are being developed to use half the frequencies for outgoing signals and the other half for incoming signals. Of course, that reduces the number of frequencies available by half—and then some because you need a buffer between the outgoing and incoming signals.

Who will win the debate? It is hard to say. Baseband certainly deserves respect, especially because Apple and AT&T have thrown their weight behind it. But wait a minute. IBM has chosen broadband, and if any company has the potential to break down walls and influence the market, it is Big Blue. For now, the game remains tied.

The Lay of the LAN

The scheme of creating an LAN and linking all the components together is called a *topology*. In theory, three main topologies dominate the market: bus, star, and ring. However, in practice, some manufacturers are fusing two topologies together to increase performance.

The *bus network* (sometimes called a tree network) consists of a single cable with taps for each microcomputer and peripheral. As a result, expanding the system is exceptionally easy, and the LAN will continue to operate if a single workstation malfunctions. However, bus networks often require a minimum distance between taps to reduce noise. Furthermore, tracking down a suspected fault in the system means checking every component of the system, or at least every component between a pair of repeaters. A bus network is excellent for sending short messages.

A *star network* uses point-to-point paths between a centralized host and the microcomputers and peripherals. All communications funnel through the central host. Maintenance can be simple or catastrophic. If one of the workstations malfunctions, you can pinpoint trouble immediately. If the central host malfunctions, the entire LAN shuts down. A star network is good for shared databases, but is not well suited for simple message switching.

A *ring network* consists of a circle of microcomputers and peripherals. It offers a faster response time than the other two topologies, and all stations constantly monitor the system. While a ring network offers greater equipment reliability, loss of one station may shut down the entire system. It is difficult to service and even more difficult to expand.

Enter the Fast LANe

LAN manufacturers employ a variety of schemes to place signals into the LAN and keep them from getting crossed. For most people, the method does not matter as much as the performance, but subtle differences in the schemes affect performance.

Polling is most often used in the star topology. The master network server waits for a signal from one of the microcomputers and then processes it.

Reservation, another favorite for star topologies, permits the transmission of signals at preselected times. Note that reservations occur several times per second. If another signal has exceeded its reserved time, that signal has priority on the network and any new signals must wait for an opening.

Slotted ring, used in ring topologies, passes a master signal (called a frame) from station to station. This frame, a series of bit patterns, marks the beginning and end of a signal and holds its destination. The transmitting microcomputer grabs the frame, inserts a signal, and sends it into the network. The signal goes to its destination, where the receiving station replaces the signal with a verification code and sends the frame back to the transmitting microcomputer. The transmitting microcomputer takes the code out, marks the frame empty, and passes the frame into the LAN, where the next station grabs it and the process begins anew. This is a most inefficient system, for it requires much reading and replacing.

A more efficient scheme is *token passing*. The token is much like the frame. However, once grabbed, the transmitting microcomputer alters the bit patterns to indicate that a signal is coming and then inserts the signal. The receiving station takes out the signal and recreates the original bit patterns. The token then goes to the next microcomputer.

Contention schemes, popular on bus topologies and some star topologies, come in three types and follow the idea of first come, first served. *Common Sense Multiple Access* (CSMA) lets a microcomputer determine whether any other station is transmitting, and if not, starts transmitting itself. This scheme carries a real danger of two stations starting to transmit simultaneously, especially on an LAN with a long bus.

CSMA/Carrier Avoidance attempts to minimize crossing signals. When two stations do transmit at the same time, the signals are sent garbled, but the senders retransmit when they fail to receive an acknowledgement that the signal was received perfectly. The AppleTalk LAN uses this scheme.

CSMA/Collision Detection also attempts to minimize crossing signals. When two stations do transmit at the same time, they both immediately stop transmitting and wait a variable length of time before retransmitting. The Ethernet, AT&T StarLAN, and IBM PC Network LANs use this scheme.

Standard Woes

As we said before, the LAN market lacks a true standard. In a strict sense, this is not exactly true, for at least three organizations have put forward loose definitions of LAN standards. Please note that because two protocols are blessed by the same organization they cannot necessarily communicate with each other; witness the rush by LAN manufacturers to make their LANs compatible with the IBM PC Network.

The main advantage of an LAN is the ability to share expensive peripheral devices and files.

The International Standards Organization (ISO) offers the Open System Interconnection (OSI) reference model. It consists of seven layers, each of which controls a particular LAN function or feature. The first three layers are concerned with data transmission and routing; the last three are geared to user applications; and the fourth provides an interface between them. The layers are:

- Physical: governs the electrical connections of the hardware.
- Datalink: activates, monitors, and controls hardware.
- Network: establishes, maintains, and terminates connections; routes and addresses data.
- Transport: interfaces between first and last three layers; selects data routes.
- Session: controls paths between stations; controls identification and authorization functions.
- Presentation: formats, encodes, decodes, and otherwise prepares data for top (applications) layer.
- Applications: the programs with which the user works: database, word processing, electronic mail, etc.

Meanwhile, the Consultative Committee for International Telephone and Telegraph (CCITT) adopted the X.25 protocol in 1976. The X.25 standardizes data transmission and routing (the physical, datalink, and network equivalents of the ISO/OSI standards).

In addition, the Institute of Electrical and Electronics Engineers (IEEE) is forming another set of standards, including 802.4, an emerging industrial networking standard, and 802.5, a token-ring standard.

To LAN or Not to LAN

So every business with a few computers needs an LAN, right? Wrong.

Remember that the main advantage of an LAN is the ability to share expensive peripheral devices and files. If you do not intend to purchase laser printers and huge capacity hard disk drives, you have a good reason not to purchase an LAN. If your files do not require constant updating by many different people, an LAN is probably unnecessary.

Do alternatives that satisfy long-range computing needs exist? Most definitely.

If your company owns a mainframe or minicomputer with excess capacity, then hooking the microcomputer, either as a dumb terminal or as a smart terminal that can create, upload, and download data, may prove to be a solution.

In the same vein, if you own a small business and need to hook up only a few workstations, a multiuser microcomputer may be the best solution.

Telecommunications, that is, hooking up a modem to your computer and sending information over the telephone lines, can also be an inexpensive and fairly reliable solution. This can be the previously mentioned PBX system or a common, off-site network. Here at *Creative Computing*, columnists and some of our editors upload their files to CompuServe or MCI Mail. At our end, we download, edit, and format the file to our specifications—rather a neat and instantaneous solution.

Finally, if your computers and software are compatible, you can simply pass around the disks holding the relevant files.

However, sometimes none of these alternatives provides the flexibility, ease, and speed of an LAN. Perhaps you really do need to share a laser printer, hard disk drive, and files. And perhaps the electronic mail feature itself is worth its weight in gold. The array of choices available staggers the imagination, and the technical pitches by silver-tongued salesmen require the wisdom of Solomon to decipher and understand. The task is formidable, but not insurmountable, providing you consider certain aspects of LANs.

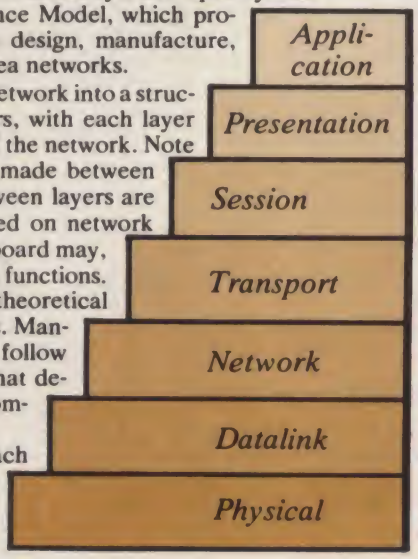
Local Area Networks

STANDARDS

In 1977, the International Standards Organization chartered a special committee to devise a set of standards for network equipment. The result of the study is the Open System Interconnection (OSI) Reference Model, which provides guidelines to those who design, manufacture, purchase, and operate local area networks.

The OSI Model divides a network into a structured hierarchy of seven layers, with each layer precisely defining a function of the network. Note that although distinctions are made between functions, the boundaries between layers are not as strict when implemented on network hardware. A single expansion board may, and often does, perform several functions. The OSI Model is more a theoretical framework than iron-clad rules. Manufacturers are not required to follow its concepts, however, those that depart from the standard risk incompatibility with other networks.

Like a wedding cake, each layer builds upon the one below it. The first three—physical, datalink, and network—lay down the rules for data transmission and routing. The physical layer defines the electrical connections of the hardware. The datalink layer sorts the data into strings of characters and readies it for sending. The network layer establishes routes for the data.



The fourth layer—transport—is an interface between the first three layers and the last three layers—session, presentation, and application. The transport layer selects the route the data will take between two terminals. The session layer coordinates the flow of data, identifying and authorizing users to operate on the system. The presentation layer prepares the data for the application layer. The applications layer holds the actual program, like a word processor or database.

Note that two different local area networks that conform to the OSI Model may not necessarily be able to communicate with each other. The rush to conform to the recently released IBM Network may help solve the incompatibility problem.—*RSL*

PLANning

Of course, your networking requirements will differ from others. The nice thing about LANs is that they can be custom designed to fit your needs. However, before settling on a particular LAN, consider the following general areas.

An LAN must provide good performance for each type of application you intend to run. If you cannot run a database program correctly or efficiently, then an LAN is practically worthless.

It should include the option of installing gateways to outside networks, especially the System Network Architecture (SNA) "standard" from IBM. Although it is not an LAN standard, more and more LANs are hooking up to SNA networks.

Make sure the LAN supports security functions. This is not meant to keep 15-year-old hackers out as much as to protect the integrity of the data from accidental change or erasure by LAN users. You also may want to allow only certain people access to personnel and payroll files.

The network should be easy to maintain. This is probably the biggest bugaboo of LANs to date and a nebulous topic at best. Different topologies require different maintenance strategies. Different companies possess differing views about maintenance. New technologies offer more risk (and gain) than old technologies. In general, when installing the LAN in the first place, provide quick identification of each component and easy access to them with adequate space around them. Let the idea that the system should be kept up and running and the down time minimal be your guiding light.

As a corollary to easy maintenance, an LAN should be easy to expand. This means both adding microcomputers and peripherals and replacing and upgrading those already on the network.

Finally, the LAN must be available. Instead of releasing a complete network at once, companies are marketing bits and pieces. IBM released the networking hardware and then made us wait for the software. The AT&T StarLAN network will not be close to completion before mid-1986. You have a choice between waiting for a "new," improved LAN and purchasing and gaining the benefits of an "old" LAN immediately.

These general guidelines are fine for the strategic overview, but certain, specific recommendations will help your tactical decisions.

Electronic mail is a feature that should be on every LAN. The ease and speed of sending an electronic memo without wasting paper and time should not be overlooked. You should be able to store, edit, discard, forward, reply, and send multiple copies of electronic messages to recognizable addresses. An added feature is the ability to set up an interactive link to send real time messages (similar to telephoning a person). These messages are not stored, but are good for coordinating activities.

An efficient and capacious print spooler is a must for those sharing a printer. In many LANs, print spooling means one person sends output to the common printer and the rest are denied access and forced to transmit output at a later time. Sitting around waiting for the printer to become available is neither pleasant nor efficient. In such situations, a print spooler with a large buffer is a must.

Make sure the LAN you buy supports the microcomputers you intend to connect. The IBM PC Network is designed to support the IBM PC family. If you own Compaqs, Zeniths, Leading Edges, or other compatibles, the PC Network may not support your clone. On the other hand, a non-IBM LAN will generally support IBM compatibles as if they were IBM PCs.

This idea extends to linking different brands of microcomputers. Although all can share the network, dividing the hard disk into separate sections for dissimilar operating systems (as most LANs do) limits file compatibility. In effect, only like computers can use like files. This gets back to the discussion of disk sharing versus file sharing. Sharing just a disk decreases cost, but sharing

files increase productivity and communication.

Centram Systems West of Berkeley, CA, claims its Tops LAN accommodates Macintoshes; IBM PCs and compatibles; Tandy TRS-80 Models 4, 12, 16, and 2000; CP/M; and Unix machines to share files. If so, and if Tops does so speedily, Centram may be offering the solution to the incompatibility problem.

Finally, consider the installation itself. For example, what are you going to do with all those cables? Leaving them lying around turns the office into Dr. Frankenstein's laboratory—not to mention creating an accident-prone area and a fire hazard. Do you place them in unaesthetic cable trays or hide them in a dropped ceiling? Or a raised floor? How about a cellular floor with a spiderweb of conduits under the floor—expensive, but it provides maximum coverage. As you can see, just creating the layout of an LAN, the cables, microcomputers, and peripherals, requires careful planning. Even then, you must allow for expansion.

LANimation

So much for the hardware considerations. However, like a microcomputer, an LAN is but a lifeless interconnection of equipment and cables without networking software. Unlike a microcomputer, your choice of network software is limited to the network you purchase. This condition may not last long after IBM releases its Network Program and Microsoft releases its highly compatible MS Network Software.

In general, the software should be simple enough for a novice to negotiate without becoming tedious for the experienced user. It should include a logical environment in which operations are executed in a straightforward manner. Working within certain parameters, it should be interactive enough to let you know where you are, what you are doing, and how to accomplish a particular task.

Often, vendors advertise that their software operates with all types of microcomputers and operating systems. While this is technically true, be sure to verify this claim with an actual demonstration. Quite often, the conversion utilities supplied with the system are dreadfully slow, which can cause a bottleneck in LAN operation.

Pricing LANguage

The cost of an LAN varies with the number of stations. The more microcomputers you add to an LAN, the lower the cost per station.

In general, media costs will be a few cents per foot of twisted-pair wire, a dollar or two per foot for coaxial cable, and roughly $10 per foot for fiber optics. Equipment connections will run $5, $40, and $50, respectively. Network adapter expansion boards run in the $500 to $700 range.

The other parts of the system are less uniform in price. Perhaps the best way to start pricing LANs is to look at a configuration for a specified number of stations—four, eight, twelve, or whatever you intend to install.

With most vendors quoting on uninstalled systems, your final total can be substantially higher than the sum of the components.

Installation costs are often shadowy figures. With most vendors quoting on uninstalled systems, your final total can be substantially higher than the sum of the components. And finding out about hidden costs—for example, using teflon-coated cable to comply with fire codes—can be close to impossible.

Fortunately, some vendors are trying to help potential customers evaluate their costs. Quadram offers first-time prospective purchasers a free program called Selectnet, which asks pertinent questions about your proposed LAN. It then goes on to pitch Quadram's offerings, but the sales spiel is subordinate to the educational value. Ungermann-Bass fields an entire network design team that provides prospective customers with quotations on network design and material needs.

Unlike a microcomputer applications program, which carries one price because it operates on one machine, networking versions carry different price structures. So far, two pricing policies are emerging as winners: per window and per user.

Per window means that the software allows a maximum number of windows to be opened on the network at once. Sorcim/IUS charges for the program itself and then charges a variable fee for a master network software manager. For example, $395 allows up to four windows on the system, while $595 lets you open eight windows. A single user could open all windows at one station, or, could close one or two to allow another user on.

Per user means that the software price is related to the number of stations. For example, MultiMate charges $595 for one user to use its word processor on an LAN, $1195 for two users, and $295 per user thereafter. Cosmos charges $950 for one user, $1495 for up to four users, $2995 for up to 10 users, and $4995 for up to 32 users of its *Revelation* database management system.

Charting New LANs

With all those LANs available, and an even greater number of LAN vendors, it is a buyer's market. The LAN Comparison Chart accompanying this article was taken from *PC Communications*, a three-volume monthly updated reference service available from Data Decisions, 20 Brace Rd., Cherry Hill, NJ 08034, (609) 429-7100.

The best way to obtain information from manufacturers and vendors is to write directly to the vice president of marketing, mention you read about their product in *Creative*, and request an information kit. In the case of Quadram, you may also want to ask for the free program *Selectnet*. The more information you have at your fingertips, the more prepared you will be to select the LAN that best fits your needs.

LAN Ho!

Buying and installing an LAN represents a significant investment in both time and money, especially when you consider the cost of training people to use it. However, that is only one part of the process. You must evaluate your needs, assess future growth, consider the size and cost, and devise an overall plan. Once you figure out what you want your LAN to do, you start the research phase and investigate the plethora of products, multitude of manufacturers, and variety of vendors.

The task is formidable, but not insurmountable. Networked microcomputers improve the flow of information, save money on peripherals, and propel us into a new era of the Information Age. Networks are the brave new world of office communications, and the productivity riches waiting in the promised LANd more than offset the effort it takes to get there. ■

Local Area Networks

COMPARISON CHART

COMPANY • PRODUCT	Type: Star	Ring	Bus	Broadband	Baseband	Access Method: CSMA/CD	CSMA/CA	Token Passing	Polling	Transmission Speed: up to 1 Mbps	1 to 2 Mbps	2 to 10 Mbps	Over 10 Mbps	Server Type: Dedicated File	Dedicated Disk	Shared File	Shared Disk	Maximum Length of Network: Up to 500 Feet	500 to 2,000 Feet	2,000 to 5,000 Feet	5,000 to 10,000 Feet	Over 10,000 Feet	Gateways: SNA/SDLC	X.25	Xerox Ethernet	Other
Altos Computer • WorkNet			•	•			•				•				•				•					•	•		
Apple • AppleTalk			•	•			•			•					•				•								•
Applitek • UniLAN			•	•	•		•		•			•									•						
AST Research • AST-PCnet			•		•		•					•					•						•				
AST Research • AST-PCnet II			•		•		•				•						•						•				
AT&T • Starlan	•		•		•		•				•				•		•		•								•
Autocontrol • AC Soft/Net			•		•		•				•				•		•				•						
Braegen • ELAN System			•		•		•					•			•							•					
Bridge • Ethernet Systems Prod.			•		•		•					•									•		•	•			•
Charles River • UniverseNet			•		•		•					•			•		•					•			•		
Complexx Systems • XLAN			•		•		•				•				•					•							
Computer Automation • SyFAnet			•	•								•			•		•		•				•	•			
Concord Data • Token/Net			•	•				•				•									•						
Contel Info Systems • ContelNet			•		•		•					•		•	•		•				•		•	•	•		•
Convergent Tech • Ethernet			•		•			•				•			•				•				•	•			•
Convergent Tech • RS-422 Net	•				•			•				•							•				•	•			•
Corvus Systems • OmniNet			•		•		•	•			•						•			•							
Datapoint • ARC			•		•			•				•									•		•	•			
Digital Microsystems • HiNet			•		•				•		•			•									•	•			•
Fox Research • 10-NET			•		•		•					•							•					•			
Goteway Communications • G/NET			•		•		•	•				•		•							•		•	•			•
Gould • MODWAY			•	•	•			•				•						•					•		•		•
IBM • PC Network			•	•			•					•		•						•							
IDEAssociates • IDEAnets			•		•		•				•				•			•									
IDEAssociates • IDEAshare	•				•			•			•				•			•									
Interlan • Net/Plus-Ethernet			•		•		•					•			•						•						
Interlan • Net/Plus-NTS10			•		•		•					•						•			•						
M/A-COM Linkabit • IDX3000	•				•						•											•					
Magnolia Microsystems • MAGNet			•		•			•			•			•	•				•								
Micom • INSTANET	•	•			•						•											•	•	•			•
Mollard Systems • Power Port			•		•			•		•					•							•					
Nestar Systems • Plan Series	•			•	•		•					•		•				•				•					
Network Reseorch • FUSION			•	•	•		•				•				•			•									•
Novell • Netware/S	•				•				•		•			•					•					•			•
Orchid Technology • PCnet			•		•		•				•				•						•						
Proteon • ProNET-10	•				•		•					•			•							•					
Proteon • ProNET-80	•				•		•						•		•							•		•		•	
Quadram • Quadnet VI			•		•		•				•			•	•					•							
Quadram • Quadnet IX	•	•			•		•				•			•	•							•					
Racal-Milgo • Planet Token Ring		•			•		•					•										•					
Santa Clara • SCS Network			•		•		•				•				•					•							
Siecor Fiberlan • Net 10	•				•		•		•			•										•					
Space Coast • Space Server	•								•		•				•		•		•								
Standard Data • STANDARDNET			•		•		•					•								•							
Standard Microsystems • Arcnet			•		•			•				•		•	•							•					
Star Technologies • STAR*NET		•			•			•				•		•	•			•									
Syntax • VAX/VMS Ethernet			•		•		•					•						•									
Syntex • LocalNet/PC Technology			•	•			•				•											•					
Tangent Tech • ThinkLink	•				•			•			•										•			•	•	•	
TCS Software • Q*NET			•		•		•					•		•	•						•						
Tecmar • ELAN			•		•		•					•			•			•							•		
Tienet • TIENET			•		•		•					•										•					•
Ungermann-Bass • Net/One			•	•	•		•					•			•			•				•		•			
VLSI Networks • 1553-NET			•		•	•	•					•			•						•				•		
XCOMP • XNet			•		•		•					•									•						
Xerox • Ethernet			•		•		•					•															
Xyplex • The XYPLEX System			•	•				•			•				•			•				•		•		•	•
Zilog • Ethernet Comm Interface			•		•		•					•						•			•			•	•	•	•
Ztel • PNX		•			•							•															
3COM • Ether Series			•		•		•					•			•			•			•						•

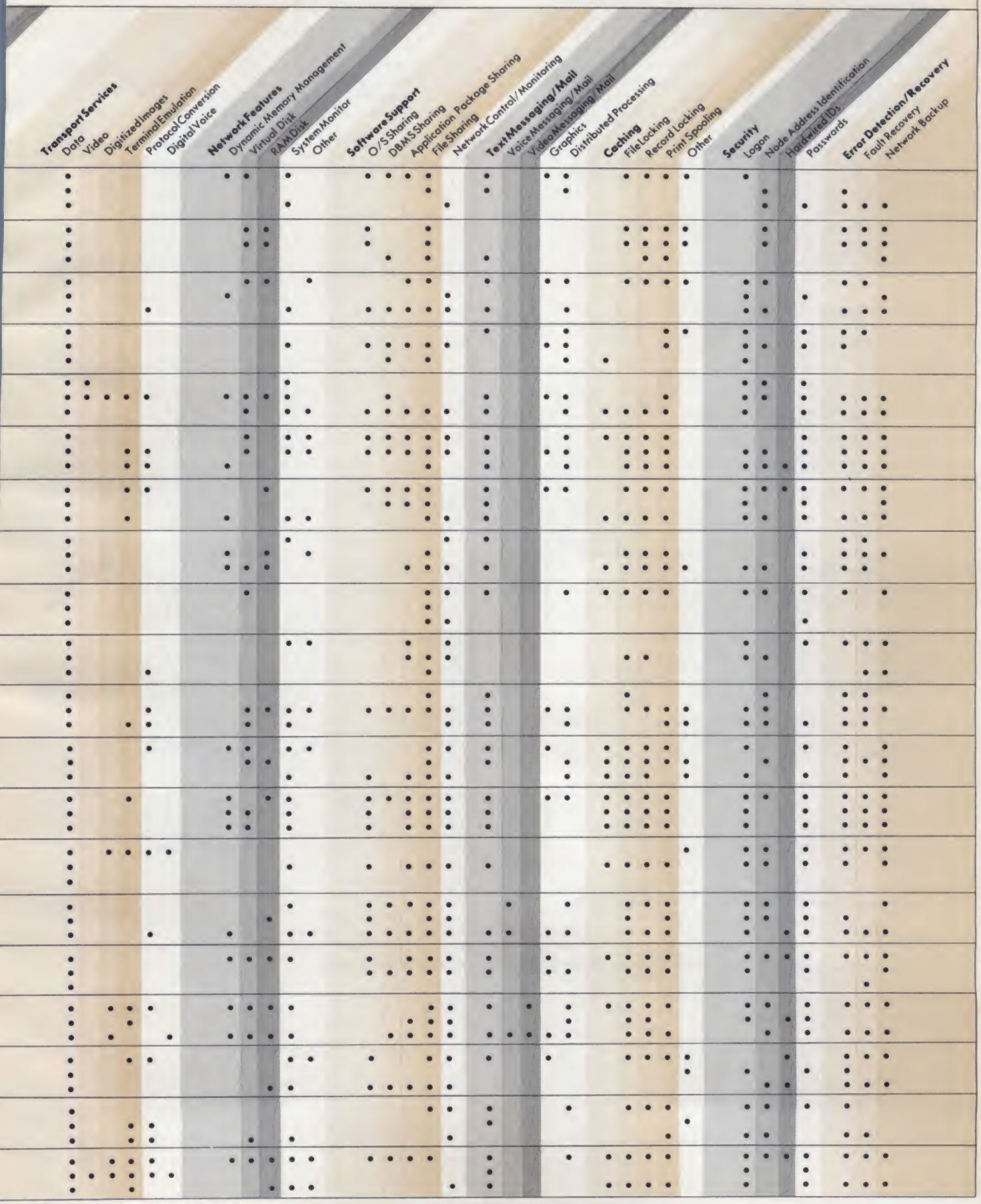


Chart information courtesy *Data Decisions*

Local Area Networks

MANUFACTURERS

Altos Computers
2641 Orchard Pkwy.
San Jose, CA 95134
(408) 946-6700

Apple Computer
20525 Mariani Ave.
Cupertina, CA 95014
(408) 996-1010

Applitek Corp.
107 Audubon Rd.
Wakefield, MA 02146
(617) 246-4500

AST Research
21 Altan Ave.
Irvine, CA 92714
(714) 863-1333

AT&T Information Systems
100 Southgate Pkwy.
Morristown, NJ 07960
(201) 898-8000

Autocontrol
11400 Darsett Rd.
St. Lauis, MO 63043
(314) 739-0055

Braegen Corp.
525 Los Caches St.
Milpitas, CA 95030
(408) 945-1900

Bridge Communications
1345 Shorebird Way
Mountain View, CA 94043
(415) 969-4400

Charles River Data
983 Concord St.
Framingham, MA 01701
(617) 626-1000

Complexx Systems
4930 Research Dr.
Huntsville, AL 35805
(205) 830-4310

Computer Automation
1800 Jay Ell Dr.
Richardsan, TX 75081
(214) 783-0993

Concord Data Systems
303 Bear Hill Rd.
Waltham, MA 02154
(617) 890-1394

Contel Information
130 Steambaat Rd.
Great Neck, NY 11024
(516) 829-5900

Convergent Technologies
2500 Augustine Dr.
Santa Clara, CA 95051
(408) 945-8877

Corvus Systems
2029 O'Toale Ave.
San Jose, CA 95131
(408) 559-7000

Datapoint Corp.
9725 Datapaint Dr.
San Antonio, TX 78284
(512) 699-7000

Digital Microsystems
1840 Embarcadero
Oakland, CA 94606
(415) 261-1034

Fox Research
7005 Corporate Way
Dayton, OH 45459
(513) 433-2238

Gateway Communications
16782 Redhill Ave.
Irvine, CA 92714
(714) 261-0762

Gould Inc.
P.O. Box 3083
Andover, MA 01810
(617) 475-4700

IBM Entry Systems
P.O. Box 1328
Baca Ratan, FL 33432
(305) 982-3326

Ideassociates
35 Durham Rd.
Billerica, MA 01821
(617) 663-6878

Interactive Systems
P.O. Box 33600
St. Paul, MN 55133
(612) 733-9817

Interlan Inc.
3 Lyberty Way
Westfard, MA 01886
(617) 692-3900

M/A-Com Linkabit
3033 Science Park Rd.
San Diego, CA 92121
(619) 457-2340

Magnolia Microsystems
4039 21st St.
Seattle, WA 98199
(206) 285-7266

Micom Systems
4100 Los Angeles Ave.
Simi Valley, CA 93063
(805) 583-8600

Mollard Systems
1977 O'Taale Rd., B-106
San Jose, CA 95131
(408) 280-7900

Nestar Systems
2585 E. Bayshare Rd.
Palo Alto, CA 94303
(415) 493-2223

Network Research
1101 Colorada Ave.
Santa Manica, CA 90401
(213) 394-7200

Novell Inc.
1170 N. Industrial Park Dr.
Orem, UT 84057
(800) 453-1267 (801) 226-8202

Orchid Technology
47790 Westinghause Dr.
Fremont, CA 94539
(415) 490-8586

Proteon Inc.
4 Tech Circle
Natick, MA 01760
(617) 655-3340

Quadram
4355 International Blvd.
Norcross, GA 30093
(404) 923-6666

Racal-Milgo
1601 N. Harrisan Pkwy.
Sunrise, FL 33323
(305) 475-1601

Santa Clara Systems
1860 Hartog Dr.
San Jose, CA 95131
(408) 287-4640

Siecor Fiberlan
P.O. Bax 12726
Research Triangle Park, NC 27709
(919) 544-3791

Space Coast Systems
301 S. Washingtan Ave.
Titusville, FL 32796
(305) 268-0872

Standard Data Corp.
3040 SW 10th St.
Pampano Beach, FL 33069
(800) 327-5567

Standard Microsystems
35 Marcus Blvd.
Hauppauge, NY 11788
(516) 273-3100

Star Technologies
5 Studebaker
Irvine, CA 92718
(714) 768-6460

Syntax Systems
6642 S. 193rd Pl.
Kent, WA 98032
(206) 251-8438

Sytex
1225 Charleston Rd.
Mountain View, CA 94043
(415) 966-7330

Tangent Technologies
5720 Peachtree Pkwy.
Norcross, GA 30092
(404) 662-0366

TCS Software
6100 Hillcraft
Houstan, TX 77081
(713) 771-6000

Tecmar
6225 Cochran Rd.
Solon, OH 44139
(216) 349-0600

Tienet
2015 Tenth St.
Boulder, CO 80302
(303) 444-2600

Ungermann-Bass
2560 Mission College Blvd.
Santa Clara, CA 95050
(408) 496-0111

VLSI Networks
2631 Manhattan Beach Blvd.
Redanda Beach, CA 90278
(213) 536-0781

Xcomp
4223 Ponderosa Ave.
San Diego, CA 92123
(619) 573-0077

Xerox Corp.
800 Long Ridge Rd.
Stamford, CT 06904
(203) 329-8700

Xyplex
100 Damina Dr.
Concord, MA 01742
(617) 371-1400

Zilog
1315 Dell Ave.
Campbell, CA 95008
(408) 370-8000

Ztel
181 Ballard Vale St.
Wilmingtan, MA 01887
(617) 657-8730

3Com
1390 Sharebird Way
Mountain View, CA 94043
(415) 961-9602

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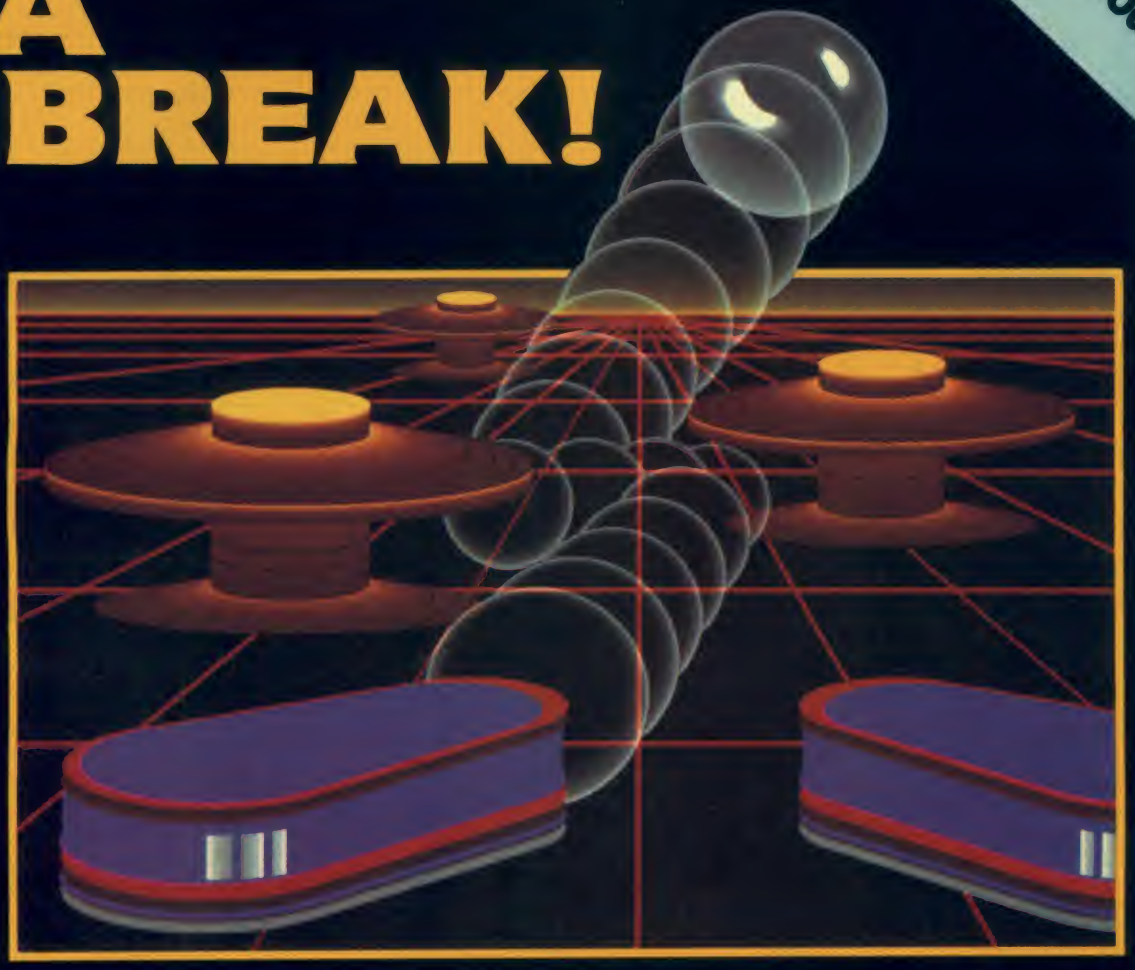

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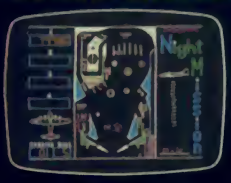

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or write or call for more information.

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subLOGIC Corporation
713 Edgebrook Drive
Champaign IL 61820
(217) 359-8482 Telex: 206995

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You've always had an ear for music. Now you have a mind for it.

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The CX5M is the first computer with true musical talent. The first and only computer with an FM digital tone generator (the same kind used in our DX synthesizers) built into it. For incredible musical accuracy and realism.

Also built into the CX5M is a polyphonic synthesizer program with 46 preset voices

and 6 rhythm patterns including drums, bass and synchronized chords. A sequencer with a 2000-note memory/playback capacity. And user-selectable parameters for editing the preset voices. So if you have something else in mind, the CX5M will listen to you.

But maybe the voices you hear in your head are vastly different from the preset voices. Buy the optional FM Voicing Program and you increase programming power by leaps and bytes. With this increased power you can extensively edit the preset voices. As well as create totally new ones.

Other music software programs available for the CX5M include the FM Music Composer which lets you create musical compositions in up to eight parts with complete control over voices, volume, expression markings, tempo, and key and time signatures.

An FM Music Macro Program which lets you take advantage of the voicing and performance potential of the CX5M within the framework of an MSX® Basic program.

And a DX7 Voicing Program. (More on this in another ad.)

And because the CX5M is an MSX computer, it runs MSX cartridge and cassette tape programs. So in addition to music, you can work your finances. Write letters. Take a break from that musical score and rack up a score of a different kind on a video game.

The CX5M is one smart, versatile, musician-friendly machine.

And a well connected one, too. Its extensive input/output jacks and ports let you save edited and created voices, scores and programs on cassette tape. Print out scores, voice parameters, letters, charts and graphs in hard copy. And connect the CX5M to any MIDI-compatible piece of equipment.

What else can the CX5M do? What else did you have in mind?

For the answer, see your authorized Yamaha Professional Products retailer. Or call 1-800-821-2100 and ask for Operator C10. In Canada, write: Yamaha Canada Music Ltd., 135 Milner Ave., Scarborough, Ontario M1S 3R1.

MSX is registered trademark of Microsoft Corp.
Video monitor, FM Music Composer Program, and 49-key YK-10 keyboard shown are optional.

YAMAHA®

WHAT'S NEW

The latest in hardware and software/**Russ Lockwood**

Dick Tracy II

Our June 1985 cover story featured the Seiko Wrist Terminal for the IBM PC. Seiko has announced the same system for the Apple II series. It retails for $199.

Seiko
1330 W. Walnut Pkwy.
Compton, CA 90220
(213) 603-9550

CIRCLE **420** ON READER SERVICE CARD

Topaz Power Conditioners

Topaz has introduced the Line 1 Power Conditioner and Line 2 Power Conditioner to protect computers against electrical noise and voltage fluctuations. The Line 1 provides a maximum of 132 dB of common-mode noise attenuation and up to 95 dB of normal-mode noise attenuation. In addition, the Line 1 can reduce input voltage by 5% or boost it 7.5% to assure consistant voltages. The Line 2 corrects voltage to within −8% and +4% of normal rated voltage for input variations of 90 VAC to 138 VAC.

The Line 1 carries a suggested retail price of from $335 to $1085, depending on power rating, and the Line 2 costs from $410 to $1590, also depending on power rating.

Topaz
9150 Topaz Way
San Diego, CA 92123
(619) 279-0831

CIRCLE **423** ON READER SERVICE CARD

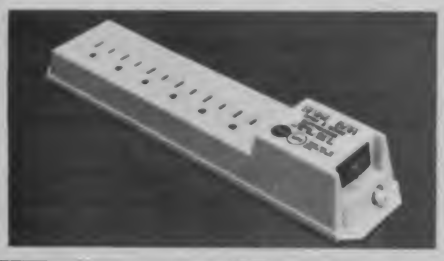
Hayes Intelligent Buffer

Hayes Microcomputer Products has released the Transet 1000, a multifunction print and telecommunications buffer that can simultaneously send and receive data via modem while sending data to a printer. It also serves as a 24-hour-a-day mailbox capable of storing electronic messages even while the computer is off.

Other features include date-time stamping, overflow control, dynamic memory allocation, E-mail scanning, print formatting, space compression, and collated printing. The Transet 1000 connects to the IBM PC, Apple IIc, and Apple Macintosh and retails for $399.

Hayes Microcomputer Products
P.O. Box 105203
Norcross, GA 30348
(404) 441-1617

CIRCLE **421** ON READER SERVICE CARD



Surge Protector

Tripp Lite has introduced the Spike Bar, a $49.95 power spike and noise suppressor with six outlets.

Tripp Lite
500 N. Orleans St.
Chicago, IL 60610
(312) 329-1777

CIRCLE **424** ON READER SERVICE CARD

Zoom Modem

Zoom Telephonics has announced the Zoom Modem PC 1200, a 1200/300 baud internal modem for the IBM PC family. It includes the "demon dialer" function, which automatically redials busy numbers until it connects; a voice synthesizer interface; touchtone recognition; and Hayes compatibility. Zoom promotes the PC 1200 as the "first open architecture modem" and notes that the hardware can be customized and controlled by modifying its EPROM firmware using the high-level Zoom Command Language. The modem retails for $429.

Zoom Telephonics
207 South St.
Boston, MA 02111
(800) 631-3116
(617) 423-1072

CIRCLE **422** ON READER SERVICE CARD

Check Out These Newsletters

Camden Communications publishes a group of computer-specific newsletters and magazines which are generally not available on newsstands. *Geneva News*, for example, is a 12-page newsletter for owners of the Epson Geneva. The first issue contains information on the RS-232 interface, *WordStar* patches, communications protocols, and BIOS calls in Basic.

Camden titles include *Geneva News* (monthly), *Epson World* (quarterly, covers QX-10, QX-16, and printers), *Professional Computing* (bi-monthly, covers HP micros), *Data General MicroWorld* (DG/One), *Portable 100/200* (Tandy portables), and *Tandy 2000*.

Camden Communications
Highland Mill
Camden, ME 04843

Hard Disk Board

Plus Development has unveiled the Hardcard, a 10Mb hard disk on an expansion board that plugs into the IBM PC. The $1095 Hardcard comes complete with electronics, controller, and file management and installation software.

Plus Development
1778 McCarthy Blvd.
Milpitas, CA 95035 CIRCLE **425** ON
(408) 946-3700 READER SERVICE CARD

C. Itoh Printers

C. Itoh has introduced several new printers.

The $1295 ProWriter 24LQ is a 24-pin printhead, dot matrix printer that prints 200 cps in draft mode, 130 cps in memo quality mode, and 67 cps in letter-quality mode. It includes seven-color

printing capability and can produce graphics resolution of up to 360 x 360 dots per inch. It includes a 16K buffer, tractor and friction feed, and either a Centronics parallel or serial port.

The $549 ProWriter 8510S plus NLQ, a 180 cps dot matrix printer with 2K buffer, is compatible with the IBM PC family and the Apple Macintosh.

The $299 ProWriter jr., designed for the IBM PC and Apple II families, is a 105 cps dot matrix printer with a Centronics parallel port. It includes a built-in printer stand and is software programmable in nine languages.

C. Itoh
19750 S. Vermont Ave.
Torrance, CA 90502 CIRCLE **426** ON
(800) 423-0300 READER SERVICE CARD

Databases

CDA International Software has released *Datamaster*, a $495 database management system for computers running CP/M, MP/M, PC/MS-DOS, and Oasis operating systems. It provides mixed fields, linked screens, modifiable record structures, and a report generator.

CDA International
14900 Ventura Blvd.
Sherman Oaks, CA 91403 CIRCLE **427** ON
(818) 986-3233 READER SERVICE CARD

Postley Software has announced *DBS/Experience*, a database management system for 64K IBM PCs and compatibles. It features fast retrieval time, a "ditto" key to copy information between records, selective updating, arithmetical computations on stored data, expandable fields, and a report generator. It retails for $345.

Postley Software
6855 Hayvenhurst Ave.
Van Nuys, CA 91406 CIRCLE **428** ON
(818) 781-2912 READER SERVICE CARD

Basic XE for Atari

Optimized System Software has released Basic XE programming language for the Atari XE line. Basic XE contains new commands, is compatible with Atari Basic, addresses the extra RAM of the XE computer, and runs Basic programs two to six times faster than Atari Basic. Basic XE, with reference manual, OSS Supercartridge, and extension disk, sells for $79.

OSS
1221 B Kentwood Ave.
San Jose, CA 95129 CIRCLE **429** ON
(408) 446-3099 READER SERVICE CARD

Apple II Fantavision

Broderbund has announced *Fantavision*, a special effects generator and full-screen animation system for the Apple II. Artists can draw two shapes and the program will generate the intervening shapes to create smooth animation. The suggested retail price is $49.95.

Broderbund
17 Paul Dr.
San Rafael, CA 94903 CIRCLE **430** ON
(415) 479-1170 READER SERVICE CARD

Business Graphics

Analytics International has released version 2.0 of *MonoGrafx*, a business graphics program for IBM PCs with monochrome monitors and without graphics adapters. The program creates organizational charts, calendars, bar charts, schedules, and flow diagrams. It can import ASCII text, works with a color adapter, includes pull-down menus, and supports 50 dot matrix printers. *MonoGrafx* runs on a 128K IBM PC and retails for $69.95.

Analytics International
1365 Massachusetts Ave.
Arlington, MA 02174 CIRCLE **431** ON
(617) 641-0400 READER SERVICE CARD

Business Accounting

Decision Support Software has released *The Business Accountant*, a general ledger package for small business owners. It interfaces with Lotus *1-2-3*, *VisiCalc*, and *Multiplan*; includes two Federal tax templates; and provides profit and loss statements, financial analysis, and other reports. It requires a 256K IBM PC with graphics adapter and sells for $295.

Decision Support Software
1300 Vincent Pl.
McLean, VA 22101
(703) 442-7900 CIRCLE **432** ON
(800) 368-2022 READER SERVICE CARD

Computerizing Law Offices

The American Bar Association has set up the Legal Technical Advisory Council (LTAC) to test computer software for law offices. LTAC expects to review from 40 to 60 software systems per year covering the areas of timekeeping and billing, litigation support, database access, word processing, and docket and office management.

LTAC's first review (of TABS III and Trust Accounting System from Software Technology) is 28 pages long. Reports cost $10 each for ABA members and $25 for non-members.

For more information, contact Richard L. Robbins, LTAC, American Bar Association, 750 N. Lake Shore Dr., Chicago, IL 60611, (312) 988-5637. ■

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In PA 1-800-242-4215

CUSTOMER SERVICE & TECH SUPPORT
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Dept. A310

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Computer Mail Order
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477 East Third Street
Williamsport, PA 17701

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Ontario/Quebec

1-800-268-4559
Other Provinces

1-416-828-0866
In Toronto

TELEX: 06-218960

2505 Dunwin Drive,
Mississauga, Ontario
Canada L5L1T1

All prices shown are for U.S.A. orders.
Call The Canadian Office for Canadian prices.

HOME COMPUTERS

ATARI

130XE (128K).....CALL
520ST (512K).....CALL

800XL 64K	CALL
850 Interface	$119.00
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Spreadsheets in the

Using Supercalc to teach algorithms in mathematics/**Samuel W. Spero**

Countless businessmen and -women have proved that the spreadsheet program on a personal computer is one of the quintessential problem solving tools in today's office. What many teachers of mathematics have yet to discover is that the same spreadsheet can be used as a problem solving tool in the classroom.

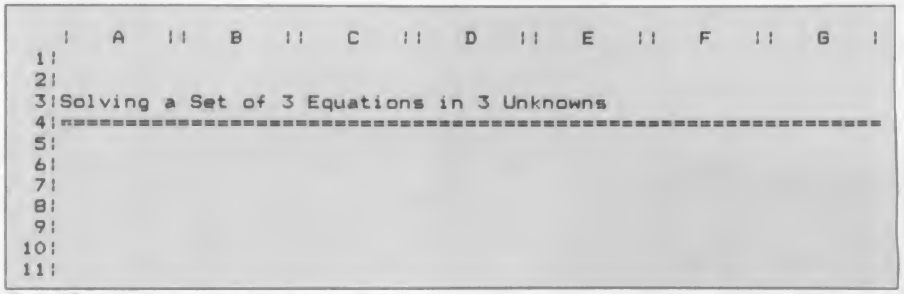
Students of mathematics have long struggled to learn the algorithms that govern numerical methods. Working out the problems by hand, even with a calculator, is often too time-consuming for all but the most trivial examples. Programming the algorithms in Basic, Fortran, or Pascal requires a knowledge of computer programming that many students lack. Using "canned" programs which require the student simply to enter data and equations does not help him learn the algorithm.

The electronic spreadsheet, however, offers an ideal compromise. It is a legitimate computer language which the student can use to articulate an algorithm. It eliminates tedious calculation. Yet it is as easy to use as paper and pencil.

The example I use to illustrate the use of the spreadsheet in the classroom in this article relates specifically to *Supercalc*. The concepts presented, however, can be applied to virtually any spreadsheet program with only minor modifications.

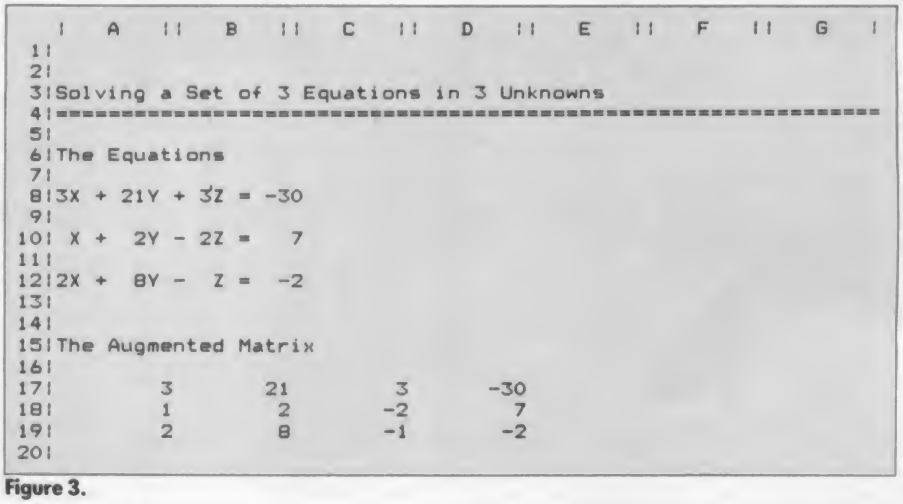
	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

Figure 1.



	A	B	C	D	E	F	G
1							
2							
3	Solving a Set of 3 Equations in 3 Unknowns						
4	==========						
5							
6							
7							
8							
9							
10							
11							

Figure 2.



	A	B	C	D	E	F	G
1							
2							
3	Solving a Set of 3 Equations in 3 Unknowns						
4	==========						
5							
6	The Equations						
7							
8	3X + 21Y + 3Z = -30						
9							
10	X + 2Y - 2Z = 7						
11							
12	2X + 8Y - Z = -2						
13							
14							
15	The Augmented Matrix						
16							
17		3	21	3	-30		
18		1	2	-2	7		
19		2	8	-1	-2		
20							

Figure 3.

Getting Started

The spreadsheet may be thought of as a grid (see Figure 1). Columns are identified by letters, while rows are identified by numbers. The intersection of a row and a column, designated by the column letter and the row number (B24, for example, is the intersection of column B and row 24), is called a cell. All the action in a spreadsheet takes place in the individual cells.

The cursor, which can be moved about the spreadsheet with the arrow keys, marks the active cell. When something is typed on the keyboard, it appears in the active cell.

Whatever is typed on the keyboard in *Supercalc* appears on the third of three lines located just beneath the spreadsheet on the computer screen—the edit line. Special commands allow you to edit entries on this line both before and after the information has been entered into the active cell.

The first of the three lines is called the status line and shows the contents of the active cell. The amount of memory available is also indicated on this line.

The second of the three lines is the prompt line. Here you find prompts that identify the type of information that can be entered. For example, when using the FORMAT, LOAD/SAVE, or REPLICATE command, the various options available under each appear on the prompt line.

Solving the Equations

To enter alphabetic information, such as the title of your problem, you type a quotation mark followed by the information. To enter the information into the active cell, you press RETURN. Let's get started by giving a title to our problem: Solving a Set of 3 Equations in

Classroom

The spreadsheet is a legitimate computer language which students can use to articulate an algorithm.

```
   |   A   ||   B   ||   C   ||   D   ||   E   |
14|
15|The Augmented Matrix
16|
17| 3         21        3         -30
18| 1         2         -2        7
19| 2         8         -1        -2
20|
21|
22|Put a 1 in the a(1,1) position
23|
24| A17/A17   B17/A17   C17/A17   D17/A17
25| A18       B18       C18       D18
26| A19       B19       C19       D19
27|
```

Figure 4.

```
   |   A   ||   B   ||   C   ||   D   ||   E   |
21|
22|Put a 1 in the a(1,1) position
23|
24|         1         7         1        -10
25|         1         2        -2          7
26|         2         8        -1         -2
27|
```

Figure 5.

```
   |      A      ||      B      ||      C      ||      D      |
27|
28|Put zeroes in column 1
29|
30| A24             B24             C24             D24
31| A25-A25*A24     B25-A25*B24     C25-A25*C24     D25-A25*D24
32| A26-A26*A24     B26-A26*B24     C26-A26*C24     D26-A26*D24
33|
```

Figure 6.

```
   |   A   ||   B   ||   C   ||   D   ||   E   |
27|
28|Put zeroes in column 1
29|
30|         1         7         1        -10
31|         0        -5        -3         17
32|         0        -6        -3         18
33|
```

Figure 7.

3 Unknowns. See Figure 2.

The three equations are entered in the same manner. Make A6 the active cell and type "The Equations. Then type "3X+21Y+3Z=–30 into A8, "X+2Y–2Z=7 into A10, and "2X+8Y–Z=–2 into A12. Of course, you would press RETURN after each item to enter it, but I will not bother to mention that from now on.

Numbers can be entered directly without quotes. Enter the coefficients of the unknowns and values from the right-hand sides of the equations in matrix form as shown in Figure 3.

In addition to text and numbers, formulas and transformations can also be entered. The variables in the formula are identified by the cell coordinates (e.g., A17) of the values to be substituted into the formula.

The method we will use to solve the equations in this example is the Gauss-Jordan elimination technique. In this method, all but one of the unknowns are successively eliminated from each of the equations until what remains is a series of equations, each in a single unknown. Elementary row operations are used to reduce the matrix of coefficients to an identity matrix. The effect of this series of transformations on the augmented matrix is to transform the augmented column vector into the solution vector.

To facilitate the elementary row transformations for computer solutions, the diagonal element in a particular row is reduced to 1. This row is then used to reduce the other elements in the same column to 0. The procedure is repeated until the matrix of coefficients has been reduced to an identity matrix and the augmented column vector reduced to the solution vector.

Starting with row 1, the entire row is divided by the value of the a(1,1) element, which in our example is 1, as in row 24 of the spreadsheet in Figure 5. The simple formulas used to generate the values in Figure 5 appear in Figure 4.

The other elements in column 1 are then set equal to 0 by an elementary row transformation. The elements in the first row are multiplied by the additive inverse of the first element in the row being transformed, which in the example is –1. These elements in the first row are added to the elements in the row being transformed, the effect of which is to place a 0 in the a(i,1) position (where i is the number of the row). This procedure, which yields the formulas in rows 31 and 32 of the spreadsheet in Figure 6, is repeated for every element in the first column as in Figure 7.

In transforming the a(2,1) element, for example, we multiply the a(1,1) element by a(2,1), subtract, and get a difference of 0. We then repeat the transformation on every element in the second row. This transformation can be written as:

a(2,j) – a(2,1) * a(1,j)

where j is the number of the column.

This formula must be replicated for all elements in the second row, i.e., for j = 1 to 3. We do this in *Supercalc* using the REPLICATE command. We need type only the formula for the first column; the formulas for the other columns can then

```
   |   A   ||   B   ||   C   ||   D   ||   E   ||   F   ||   G   |
33|
34|Put a 1 in the a(2,2) position
35|
36|         1         7         1       -10
37|         0         1        .6      -3.4
38|         0        -6        -3        18
39|
40|Put zeroes in column 2
41|
42|         1         0      -3.2      13.8
43|         0         1        .6      -3.4
44|         0         0        .6      -2.4
45|
46|Put a 1 in the a(3,3) position
47|
48|         1         0      -3.2      13.8
49|         0         1        .6      -3.4
50|         0         0         1        -4
51|
52|Put zeroes in column 3
53|
54|         1         0         0         1
55|         0         1         0        -1
56|         0         0         1        -4
57|
58|Solution set is              (         1        -1        -4)
59|
60|X =                  1
61|Y =                 -1
62|Z =                 -4
```

Figure 8.

```
   |      A      ||      B      ||      C      ||      D      ||      E
33|
34|Put a 1 in the a(2,2) position
35|
36| A30            B30            C30            D30
37| A31/B31        B31/B31        C31/B31        D31/B31
38| A32            B32            C32            D32
39|
40|Put zeroes in column 2
41|
42| A36-B36*A37    B36-B36*B37    C36-B36*C37    D36-B36*D37
43| A37            B37            C37            D37
44| A38-B38*A37    B38-B38*B37    C38-B38*C37    D38-B38*D37
45|
46|Put a 1 in the a(3,3) position
47|
48| A42            B42            C42            D42
49| A43            B43            C43            D43
50| A44/C44        B44/C44        C44/C44        D44/C44
51|
52|Put zeroes in column 3
53|
54| A48-C48*A50    B48-C48*B50    C48-C48*C50    D48-C48*D50
55| A49-C49*A50    B49-C49*B50    C49-C49*C50    D49-C49*D50
56| A50            B50            C50            D50
57|
58|Solution set is              (    D54        D55        D56     )
59|
60|X =                  D54
61|Y =                  D55
62|Z =                  D56
```

Figure 9.

be replicated with those factors that are to be treated relatively being treated relatively, and those factors that are to be treated absolutely not being changed at all. Larger nxn matrices are only slightly more time-consuming to calculate than our simple 3x3 example.

The other columns and rows in the matrix are dealt with in a similar fashion. Figure 8 shows the applicable formulas, and Figure 9 shows the results of the manipulations.

More Applications

The lesson to be learned from the example presented here is that virtually no knowledge of traditional computer languages is necessary to program the algorithm. Because the goals of mathematics instruction do not include programming as an instructional objective but do include practice in using algorithms to solve problems, the electronic spreadsheet can be a very useful tool for students.

Specific areas in which spreadsheets can be used in college algebra include the study of linear, quadratic, and general polynomial functions; matrices, and simultaneous equations. In calculus classes, spreadsheets can be used in the study of Newton's Method for solving non-linear equations, applications of the Trapezoidal Rule, Simpson's Rule, and other numerical integration algorithms; and infinite series. Techniques for solving differential equations and for determining inverses and determinants of matrices can also be explored using spreadsheets. ■

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Programs that Understand Language

How they do it—syntax-directed methods/**William Wright**

Language is an interaction between words. Arranging the same words in different ways causes different interactions:

The boy abandoned his own dreams of happiness (Despair)

The abandoned boy dreams of his own happiness (Hope)

The interactions that occur in natural languages (our conversation and literature) are too complex for today's computing techniques. When we exchange information with a program, we must resort to an artificial language with simplified grammar and semantic rules. The purpose of this article is to explain several programming methods for understanding or *parsing* artificial language. These methods can't cope with natural language, but they do allow us to proceed with workaday applications of language like compilers, question answering programs, and operating systems.

An Overview

Since a language allows different arrangements of the same words, it follows that a parser cannot apply the same format specification to every sentence. An input statement like INPUT X,A$,Y is not true parsing—unless we consider the input to be a degenerated one-syntax-rule language. The following code is not parsing either, because it treats the input as a single unit rather than as a string of interacting words:

```
INPUT A$
IF A$="LET I=5" THEN . . .
IF A$="LET I=6" THEN . . .
IF A$="LET I=7" THEN . . .
. . . (etc) . . .
```

Why examine words individually? For one thing, most languages have too many sentence possibilities. The dictionary of all legal sentences would quickly exceed the memory of any computer. Equally as important, constructing a dictionary of sentences would imply that we were able (and willing) to anticipate all the ideas that the user of the language would want to express. If languages were merely dictionaries of previously defined statements, we couldn't use them to express new ideas or ask new questions.

The implications don't stop here either. If we must consider the assembly of individual abstractions (words) into complete ideas (sentences), then we are considering artificial intelligence. One of the enticements of language processing is that it allows (forces?) us to experiment with the ultimate computer application: machine intelligence. Most of the parsing techniques described in this article apply to artificial intelligence just as much as they do to language.

For the remainder of this article, *word* will mean any character string that is an elemental unit of meaning in a language. Thus numbers (strings of digits) and arithmetic operators (such as + and –) are words in most programming languages. A *sentence* is any string of words that satisfies the rules of the language for sentences.

An Introductory Parsing Automaton

We use the term *automaton* or *machine* to suggest that the response of the parser to a sentence is automatic and predetermined. The automaton consists of a loop and a data table. The loop successively examines each word in the sentence and uses the information in the table to spot syntax errors, to translate the words, and to integrate the translations into a complete meaning for the sentence. The table is organized into rows. Each row is called a *state* and represents the rules (syntactic and semantic) for a unique use of a particular class of words:

STATE1:	WORD1	ACTION1	NEXT1
	WORD2	ACTION2	NEXT2
	WORD3	ACTION3	NEXT3
	ERROR	ERR-MSG	
STATE5:	WORD5	ACTION5	NEXT5
	WORD6	ACTION6	NEXT6
	ERROR	ERR-MSG	

In a job control language, STATE3 might represent a use of filenames, while STATE6 might represent some other use of filenames. STATE2 might be a use of integers, and so on.

WORD is the name (or other symbolic representation) of a subroutine that knows the spelling rules for a class of words. Typical word classes in a programming language might be: integer, floating point number, arithmetic operator, comment delimiter, variable name, or keyword. WORD examines the current word from the sentence and decides whether or not the word satisfies the spelling rules of the class. For example, the subroutine to test if the current word is a properly spelled integer might look like this:

```
SPELL=1
FOR L=1 TO LEN(WORD$)
        I$=MID$(WORD$,L,1)
        IF I$<"0" OR I$>"9" THEN SPELL=0
NEXT L
RETURN
```

After calling this subroutine, the parser can check SPELL to see whether the spelling of the word was accepted or rejected (1=accepted, 0=rejected).

The parser begins by calling WORD1. If WORD1 doesn't accept the first word of the sentence, the parser will call WORD2, and so on. If none of these states accepts, the parser will arrive at ERROR, which is a subroutine that prints the error message named by ERR-MSG.

On the other hand, if one of the states accepts, the parser will call the ACTION for that state. For example, if WORD3 accepts, the parser calls the subroutine named by ACTION3. Action subroutines are part of the main program that called the parser originally. The parser is returning control to the main program for a few moments, so that the program can do something with the word. Depending on the application, the action might be as simple as storing the translation somewhere, or it might be a complex set of calculations. ACTION is where the semantic meaning of the word is analyzed.

After ACTION returns, the parser moves to the state named by the NEXT of the accepting state. If WORD3 accepts and NEXT3 contains the name of STATE5, the parsing loop will begin at STATE5 when it examines the next word in the sentence.

In summation, the table is a compact and convenient technique for instructing the parser: "Once you identify something in the sentence (WORD), I will tell you what to do with it (ACTION) and what to accept next from the sentence (NEXT)."

A flow chart is shown in Figure 1. We will discuss the BAD-ACTION box later. To illustrate the operation of the automaton, consider these two sentences from a hypothetical programming language:

```
GO: INC  SIZE
    BEQ  GO
```

In these sentences, GO and SIZE are symbolic names. INC and BEQ are executable instructions (increment and branch-if-equal). The table might look like this:

```
STATE1: INSTRUCTION OUT-INSTR  STATE6
STATE2: SYMBOL      DEF-SYMBL  STATE4
        ERROR       NOT-INSTR
STATE4: COLON       OK-COLON   STATE1
        ERROR       NOT-COLON
STATE6: SYMBOL      LOOK-SYM   0
        ERROR       NOT-SYMBL
```

During a parse of the first sentence, the sequence of events would be:

STATE1 rejects GO because it isn't an INSTRUCTION
STATE2 accepts GO because it is a SYMBOL, calls DEF-SYMBL, and then moves to STATE4
STATE4 accepts : because it is a COLON, calls OK-COLON, and then moves to STATE 1
STATE1 accepts INC because it is an INSTRUCTION, calls OUT-INSTR, and then moves to STATE6
STATE6 accepts SIZE because it is a SYMBOL, calls LOOK-SYM, and then exits (because NEXT = 0)

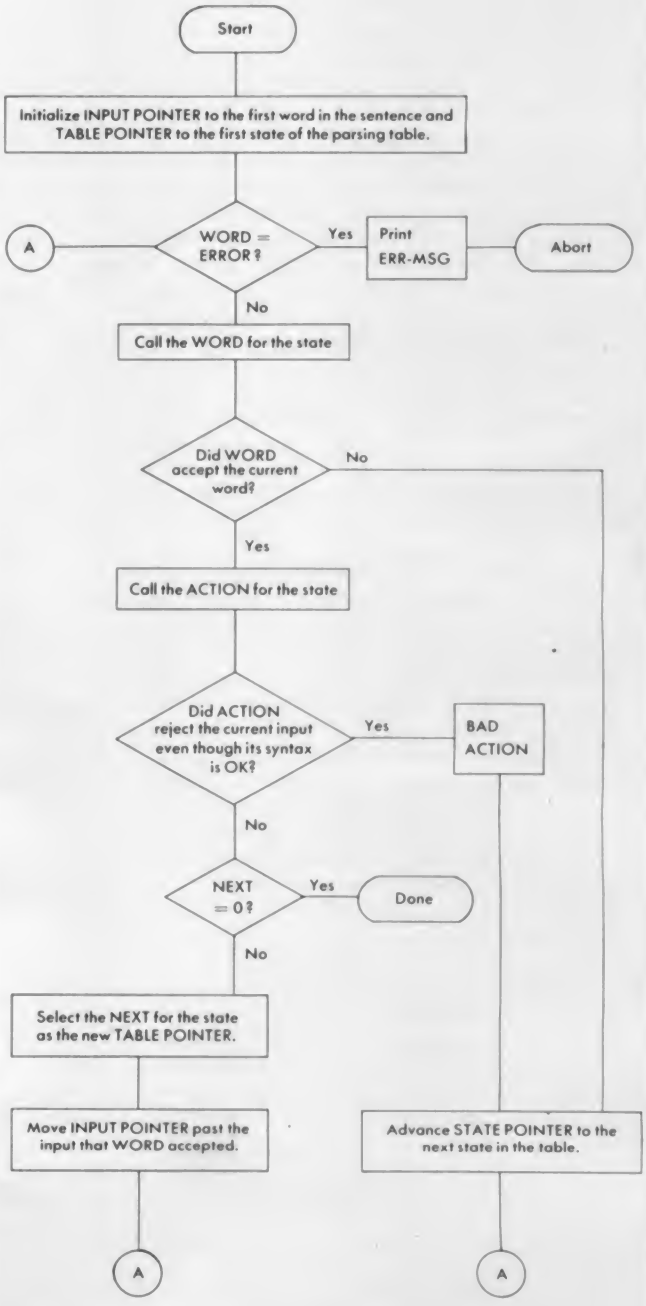
For the second sentence, the events would be:

STATE1 accepts BEQ, calls OUT-INSTR, and then moves to STATE6
STATE6 accepts GO, calls LOOK-SYM, and then exits (because NEXT = 0)

In this hypothetical language, symbolic names have two different usages, and the automaton calls a different ACTION for each usage. When the symbol begins a sentence (as in GO:), the symbol defines a location in the source code, and the automaton asks DEF-SYMBL to make a record of the location. When the symbol follows an instruction (as in BEQ GO), the symbol is a reference to a location defined elsewhere, and the automaton asks LOOK-SYM to look it up.

Moving from one state to another is called *transition*, suggesting that the expectations of the parser will change each time it recognizes a word in the sentence. Initially the automaton expected either an instruction or a symbol (STATE1/

Figure 1. Flow chart for introductory automaton.



STATE2). After recognizing a symbol (GO), the automaton expected only a colon (STATE4). Each NEXT predicts the word classes that might appear next in a legal sentence.

The completion of the parser is signalled by the table (NEXT=0), not by the end of the sentence. One of the duties of the parser is to decide whether the sentence contains either too few or too many words. If the final word does not appear exactly when expected, the sentence contains a syntax error. (Carriage-return is a word in most languages.)

The parser is in trouble if it reaches an ERROR. Since no state accepted the current word, the parser can't know which NEXT to use for the rest of the sentence. The parser must abort because it cannot predict what words should come next. This is an important issue to which we will return later.

We have glossed over the difference between action and translation. For example, all integers receive the same translation—character string to numerical quantity—but they cause different actions depending upon their usage. In Basic, an integer can be used as either a statement label or a number (e.g., 10 A = 10). To make the parser more compact, we can place the translation operation in WORD rather than repeating it in several different ACTIONs. Every ACTION must know where its WORD left the translation. This technique applies only when the translation of a word is independent of its usage in a sentence.

States That Call Other States

A phrase can have more than one use, just as a word can. Consider an arithmetic expression. Programming languages allow an arithmetic expression after =, before or after a relational operator, as an array subscript, etc. To parse the expression, the automaton will need a sequence of states. Rather than cluttering the table with repetitions of this sequence, we can limit the table to a single instance which other states can call—as program calls a subroutine. This is how it would look:

```
CALL    SEQUENCE    ACTION    NEXT
```

CALL is a special subroutine that saves (makes a copy of) the location of the current state and substitutes SEQUENCE in its place. As a result, the sequence will direct parsing until something tells the automaton to return to the calling state (by reversing the substitution). NEXT=0 and ERROR are the obvious candidates for causing a return. NEXT=0 will mean a successful return (the sequence accepted), and ERROR will mean an unsuccessful return (the sequence rejected).

An illustration is shown below. Both STATE6 and STATE12 call the sequence at STATE16. If the sequence accepts (STATE18 accepts), the automaton will return and execute ACTION6/ACTION12. Then the automaton will move to STATE49/STATE92. If the sequence rejects (reaches STATE17), the automaton will return and fall through to ERROR7/ERROR13 with calling any ACTION.

Notice that ERROR 17 does not have an ERR-MSG. This is because an error has not occurred yet. We are using ERROR as a shorthand for "call failed," not for "parse failed." The section of the table that issues the call must decide whether or not an error has occurred. Another point: since the call may have processed several words before reaching ERROR, the automaton must be prepared to restore the input pointer to its original value before it returns from the call.

Preliminary Lexical Scan for Efficiency

The automaton has an inefficiency: the same word will be checked for spelling by many states until one state accepts or all of them reject. It would be more efficient to check the spelling of each word only once, before the parse begins, to identify its lexical type: digit string, alphabetic string, arithmetic operator, etc. With this information, the parser could avoid calling many WORDs unnecessarily. For example, if the word is "49," it would be a waste to execute the WORDs for variable names and keywords (which must begin with letters).

Other Refinements

If a word class contains only one word (e.g., COLON contains only :), WORD can be the actual word rather than the name of a subroutine. This eliminates the overhead of a subroutine call. The automaton must represent subroutine names with symbols that can't be confused with printed characters.

Some states won't need an ACTION. For example, punctuation marks often serve as separators and don't carry any information that requires action. Rather than cluttering the table with ACTIONs that do nothing, we can have a convention (such as setting the high bit of WORD) that indicates no action.

Sometimes it is convenient to call ACTION or move to NEXT without processing any words from the sentence. For this, the automaton needs a WORD that does nothing or a convention that indicates no WORD. For example, the automaton may want to hop over an ERROR if a missing word was optional, or it might want to perform a final action after a complete phrase or sentence has been processed.

Semantics vs. Syntax

Words can satisfy the syntax of a language while violating its semantic rules. For example, 50 GOTO 1000 is good syntax, but it would be illegal semantics if no other sentence began with 1000. To handle such situations, the parser has a BAD-ACTION routine to which any ACTION can branch in case of semantic error. BAD-ACTION does whatever bookkeeping is required to simulate ERROR. The flow chart in Figure 1 shows a BAD-ACTION.

We have been discussing syntax-controlled automatons. The spelling and location of each word in the sentence determines unambiguously which ACTION should be called and which state should be used as NEXT. However, there are situations in which we would like semantics (action subroutines) to influence the operation of the automaton. For example, assembler

```
STATE6:     CALL      STATE16    ACTION6     STATE49
            ERROR7    ERR-MSG7
            .         .          .
            .         .          .
            .         .          .
STATE12:    CALL      STATE16    ACTION12    STATE92
            ERROR13   ERR-MSG13
            .         .          .
            .         .          .
            .         .          .
STATE16:    WORD16    ACTION16   STATE20
STATE17:    ERROR17
STATE18:    WORD18    ACTION18   0
```

programming languages use the following syntax for an executable instruction:

LABEL: INSTRUCTION OPERAND ;COMMENT

The difficulty is that different instructions demand different types of operand. We could solve this problem by defining different instruction types and assigning a different word class to each type. The parsing table would have a separate state (each with its own ACTION and NEXT) for each class. However, a better solution might be a single state whose WORD accepted all instructions and whose ACTION knew which NEXT to use for each instruction.

In other words, the automaton allows ACTION to overrule or replace the NEXT in the table. If nothing else, this improves the efficiency of the parser because it avoids calling several WORDs to identify a single instruction. Also, this technique concentrates the knowledge the parser has about operand types in a single action subroutine, rather than scattering the knowledge throughout a large table.

This technique admittedly violates some of the axioms upon which formal automaton theory depends, but no formal theorem can cope with all aspects of language anyway. We might say that our action subroutines are "intelligent" enough to cope with ambiguous or even contradictory syntax. One of the unsolved problems of all machine intelligence applications, including language processing, is how a program should decide when to abandon rigorous logic and "play the odds" instead. Perhaps this famous example will whet your appetite:

Time flies like an arrow.

A computer program at Harvard University found four syntaxes that match the above sentence:

- Time moves through the air in the same manner as an arrow does. (*Flies* is the verb)
- Measure the speed of a housefly by the same means as you would measure the speed of an arrow. (*Time* is the verb)
- Measure the speed of houseflies that resemble an arrow. (*Like* . . . an adjectival phrase, not adverbial)
- A species of housefly, called a "time-fly," admires an arrow. (*Like* is the verb)

None of the above captures the real meaning of the sentence: Time passes as quickly as an arrow in flight. Obviously, we need something besides syntax to understand this sentence. For those interested in language as an experiment in machine intelligence, the following references contain interesting chapters and are more readable than most. ■

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This discussion of programs that understand language will continue next month.

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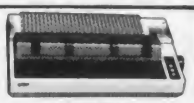

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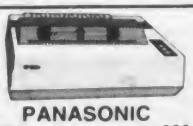

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Logo Type

Graphing functions with Logo

Robert V. Ludwig

The thing for which the Logo language is best known is turtle graphics. And what could be a more natural use of graphics than graphing functions? With the Logo Graphing Program presented here, it is easy to graph a function in either rectangular or polar coordinates and to watch the function being traced on the screen. It is also possible to get a printed copy of the graph if desired.

The Logo Graphing Program (Listing 1) is written in Apple Logo to run on the Apple II computer. Users of other versions of Logo may need to make some changes. While the program makes use of the graphics capability of Logo, it is also a good demonstration of the power of some of the other features of the language.

All of the following characteristics are present in the program.

- Logo is procedural.
- Logo is interactive.
- Logo is recursive.
- Logo is extensible.
- Logo has list handling capability.

The program consists of some 20 independent modules or procedures and begins with the main procedure GRAPH. GRAPH consists of calls to procedures ENTER.DATA, DRAW.XAXIS, DRAW.YAXIS, CHOOSE.TYPE, PRINT.GRAPH and very little else. If a program is written by first writing a main part consisting mostly of procedure calls, followed by the writing of the called procedures, we say it has been written "top down." Top down programming is considered by many to be a highly effective and efficient way of writing programs.

The first procedure called by GRAPH is ENTER.DATA which begins by asking if the screen is to be cleared. This feature demonstrates the interactive ability of Logo. It is included here to allow you to graph one (or more) functions and then, by rerunning GRAPH, to change the coordinate scales and superimpose new graphs on top of the old.

Notice that the first three lines of ENTER.DATA make you "get it right." If you do not answer either Y or N to the question posed, the procedure calls itself and the question is repeated. This is the first use of recursion in the program.

Positioning the Axes

Next ENTER.DATA calls the procedure GET.INTERVAL which is also recursive, in this case to insure that the left-hand endpoint of the interval over which the function is to be graphed is entered before the righthand endpoint. When the program returns to ENTER.DATA after executing GET.INTERVAL, the position on the screen for the y-axis is determined.

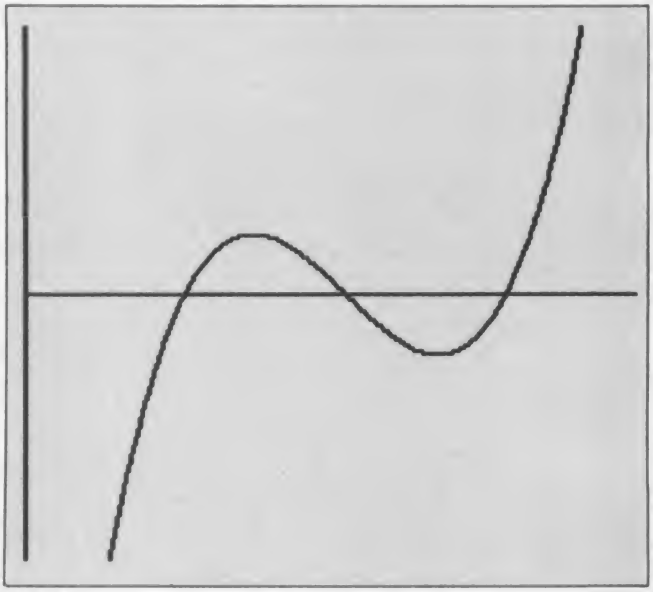


Figure 1.

Following the calculation of YAXIS.POS, ENTER.DATA asks for the position of the x-axis. Entering a 0 here will put the x-axis in the middle of the screen; entering a −79 will put it where it will just show at the bottom of the split screen.

The last thing that ENTER.DATA does is to ask for the ratio y-axis scale:x-axis scale. This allows the y-axis scale to be compressed or expanded in comparison to the x-axis scale if it is desirable to distort the graph for any reason. For example, if the zeros of a function are very close together, the scale on the y-axis may be stretched out so that the zeros are more visible. Figure 1 is a graph of the function

$$x^3 - .006x^2 + .00001 1x - .000000006$$

over the interval [0 .004] which is generated by the program in such a way as to separate the zeros. If the same scale had been used on the y-axis as on the x-axis (a scale ratio of 1), the graph would have been so close to the x-axis as to be indistinguishable from it. The graph of Figure 1 was produced by using a y-axis:x-axis ratio of 1,000,000.

Note that ENTER.DATA uses the procedures LINEFEED and SPACE, which do exactly what their names suggest. They are excellent examples of the extensible nature of Logo in that when they are used, they are indistinguishable from primitive commands. After ENTER.DATA has been completed, the program returns to GRAPH where DRAW.XAXIS and DRAW.YAXIS are executed.

Entering the Function

Following the drawing of the two axes, the program calls the procedure CHOOSE.TYPE. In CHOOSE.TYPE a decision must be made to use either a rectangular coordinate system or a polar coordinate system, and to plot either individual points only or the points connected by line segments.

The two procedures ENTER.FUNCTION and ENTER.P.FUNCTION provide for the entry of the function to be graphed, with respect to the coordinate system chosen. The entered function is saved as a list with the variable name FUNCTION. If you have chosen to graph in polar coordinates, ENTER.P.FUNCTION also requests the interval over which the angle is to vary. Once again you are required to enter the smaller number first. The interval entered in the earlier procedure GET.INTERVAL is used to put a scale on the polar axis.

GRAPH.FUNCTION and PLOT.POINT (GRAPH.P.FUNCTION and PLOT.P.POINT for polar coordinates) are the procedures which do the actual graphing. Keep in mind that you must use the coordinate system supplied by Logo in which x varies from −140 to 139 (this program uses −139 to 139 so that the y-axis can be centered on the screen) and y varies from −119 to 120 (or from −79 to 120 on the splitscreen).

For rectangular coordinates this program attempts to plot one point for each of the 279 pixels across the horizontal dimension of the screen. When the procedure GRAPH.FUNCTION is called at the end of procedure ENTER.FUNCTION, it is instructed to begin graphing at pixel −139.

The first line in GRAPH.FUNCTION will stop the graphing process when pixel 139 has been reached, at which time GRAPH.FUNCTION sounds the "bell" (CHAR 7) and branches to the procedure GRAPH.ANOTHER. In the second line of GRAPH.FUNCTION, the pen is raised before the first point is plotted so that the turtle does not "drag the pen" as he travels to that point.

The Logo primitive RUN is the instruction which causes execution of the string having variable name FUNCTION as if that string were substituted for the words RUN :FUNCTION in the program.

Graphing the Function

You impose a scale on the x-axis when you choose an interval over which to graph in the procedure GET.INTERVAL. That interval and the value chosen for RATIO in ENTER.DATA also impose a scale on the y-axis. In general the scale on the x-axis will not be the scale of −139 to 139 which Logo uses. Likewise, the scale on the y-axis will not be that of Logo.

The third line of the procedure GRAPH.FUNCTION performs a transformation from the Logo scale to your scale so that the function you have entered can be evaluated properly in the first line of PLOT.POINT. After this evaluation takes place, in the second line of PLOT.POINT a second transformation converts the y value back to its equivalent value in the Logo coordinate system.

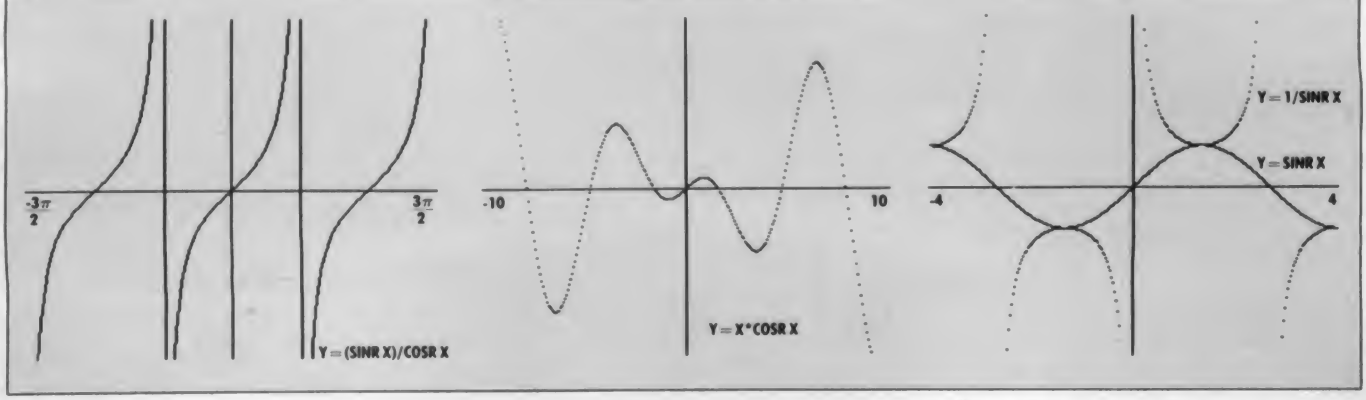
X and FX are the variable names for the x and y values to be plotted with respect to x-axis and y-axis scales you have chosen. XPOINT and YPOINT are the variable names for the x and y values with respect to the Logo scales. Lines 4 and 5 of GRAPH.FUNCTION display the abscissa of the point to be plotted.

Line 6 of GRAPH.FUNCTION is for the purpose of error trapping. The instruction CATCH "ERROR begins execution of the instructions (in this case PLOT.POINT) contained within the following square brackets. If, however, an error occurs during the execution of those instructions, execution will be abandoned, and the program will branch to the line following CATCH. Since that line is a recursive call to plot the next pixel, the program continues as though no error had occurred, except that the most recent point is not plotted.

Line 1 of PLOT.POINT demonstrates the magic of Logo string handling. The Logo primitive RUN is the instruction which causes execution of the string having variable name FUNCTION as if that string were substituted for the words RUN :FUNCTION in the program. If no error occurs during the execution of PLOT.POINT up to line 3, PLOT.POINT next displays at the bottom of the screen the ordinate of the point to be plotted. Lines 5 and 6 determine whether points are only plotted or plotted and connected.

Errors

A troublesome error can occur in PLOT.POINT if your function has incorrect syntax. In this case the program cannot plot any points as it cannot interpret the function. The



CATCH "ERROR command, however, causes Logo not to cease running and not to print an error message.

If the value of the abscissa displayed on the bottom of the screen is changing "like a spinning odometer" it means that several consecutive errors are occurring. If the error is a syntax error, the entered function will still be visible at the bottom of the screen. If the odometer effect is present and the function is not visible,there is no syntax error, and the program may eventually begin to plot.

If, however, the spinning odometer effect is present and the function is visible at the bottom, the error may be syntax or it may be "turtle out of bounds" or "division by zero" or possibly something else. Since no error message is displayed when the program is within the scope of a CATCH command, in this last case you can only wait to see if points will be plotted.

After GRAPH.FUNCTION or GRAPH.P.FUNCTION has finished execution, the first line of either procedure passes control to GRAPH.ANOTHER. If you choose to graph another function, control passes back to CHOOSE.TYPE where you again have the option of choosing either rectangular or polar coordinates, but do not have the option of changing the coordinate system scale or the value of RATIO. To change those inputs you must first quit the program and then restart it.

Printing the Graphics

The procedure PRINT.GRAPH is designed to dump to the printer a copy of whatever graphs appear on the screen. It is written to work with the Pkaso printer interface card and the Epson MX-80 printer with Graftrax Plus.

The two lines starting with .DEPOSIT are needed so that after an image is dumped to the printer, output will return to the screen without a reboot of Logo. I believe that these two lines are required by the Pkaso card, although they are not required for the Krell version of Logo. This is a trick I learned from the Logo Tool Kit which contains utilities that may be helpful for other printer, interface products.

The procedures SINR, COSR, and PI are included to help enter certain trigonometric functions and values. If you wish to get the typical graph of the sine function, for example, you must use SINR X. The Logo function SIN X returns the sine of an angle measured in degrees while the typical sine curve is for angles measured in radians. This example brings up another point. You will note that I have suggested using SINR X instead of the traditional Logo notation SINR :X.

Using SINR X instead of SINR :X is possible because of the inclusion of a procedure with the acutely short name X. The only thing this procedure does is to return the value of X (or :X as it is written in Logo). Thus when you write something such as PRINT SINR X, the X on the end is really a call to execute the procedure X which returns :X which then serves as input to the procedure SINR. This little trick saves you from having to write :X when you enter the function to be graphed.

Expanding the scope of the program would almost certainly require the use of shorter names, fewer redundancies, more multiple command lines, and other tricks to reduce the size of the program.

Additions and Enhancements

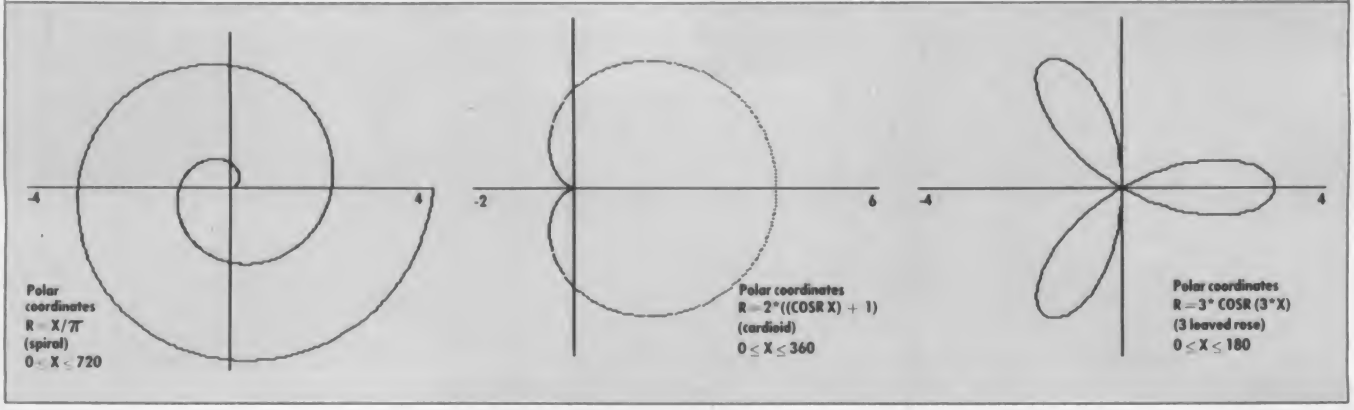
I do not wish to leave you with the impression that I consider this to be a completed "commercially acceptable" program. The program as it now stands will, for example, quit with an appropriate error message if non-numeric data are entered when numeric data are expected. I would consider such a response unacceptable in commercial software.

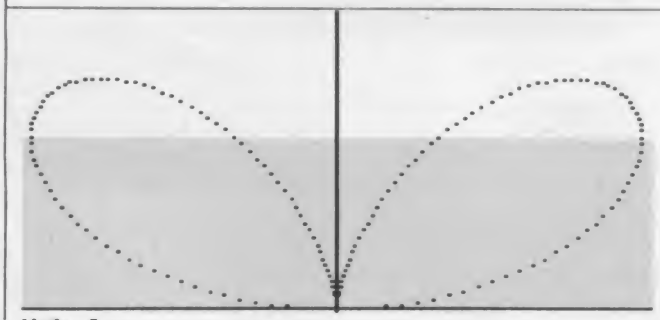
There are other features which might have been included in this program. For example, you might want to graph different functions in different colors or to graph using parametric equations. Another possibility would be to include procedures to evaluate functions such as the log, exponential, and power functions, which Apple Logo does not provide.

I have not added more to the program for two reasons. The first is that it was my intention to present the program as a tutorial for those who are not advanced Logo programmers.

An even more compelling reason for not extending the scope of the program is that I am starting to run out of space. I am not sure how much the program can be expanded within the confines of a 64K Apple, but some compromises might have to be made to do so. Expanding the scope of the program would almost certainly require the use of shorter names, fewer redundancies, more multiple command lines, and other tricks to reduce the size of the program.

One final note. The program runs slowly. Although a Basic program to produce graphs would probably run faster, it is very much more difficult to write the function input routine in Basic. This is the kind of application in which the list handling capability of Logo really shines. ■





Listing 1.

```
TO GRAPH
WINDOW HT
ENTER.DATA
DRAW.XAXIS :XAXIS.POS
DRAW.YAXIS :YAXIS.POS
CHOOSE.TYPE
PRINT.GRAPH
TEXTSCREEN
END

TO ENTER.DATA
LINEFEED 2 PRINT [DO YOU WANT TO CLEAR THE SCREEN (Y/N)?]
MAKE "ANS READCHAR
IF :ANS = "Y [CLEARSCREEN] [IF NOT :
 ANS = "N [ENTER.DATA STOP]]
GET.INTERVAL
MAKE "YAXIS.POS 139 * (:A + :B) / (:A - :B)
LINEFEED 1 PRINT [WHERE DO YOU WANT THE X-AXIS]
SPACE 5 PRINT [( - 79 TO 79)?]
MAKE "XAXIS.POS READWORD
LINEFEED 1 PRINT [ENTER THE RATIO]
SPACE 5 PRINT [Y-AXIS SCALE / X-AXIS SCALE]
MAKE "RATIO READWORD
END

TO GET.INTERVAL
PRINT [ENTER IN THE FORM A B WITH A < B THE]
PRINT [INTERVAL ALONG THE X-AXIS OVER WHICH]
PRINT [YOU WISH TO GRAPH.]
MAKE "INTERVAL READLIST
MAKE "A FIRST :INTERVAL
MAKE "B LAST :INTERVAL
IF NOT :A < :B [GET.INTERVAL]
END

TO LINEFEED :NUM
REPEAT :NUM [PRINT []]
END

TO SPACE :NUM
REPEAT :NUM [TYPE [ ]]
END

TO DRAW.XAXIS :XAXIS.POS
IF OR :XAXIS.POS < -119 :XAXIS.POS > 120 [STOP]
PU SETPOS LIST 0 :XAXIS.POS PD
WRAP SETHEADING 90 FD 280 SETHEADING 0 WINDOW
END

TO DRAW.YAXIS :YAXIS.POS
IF :A * :B > 0 [STOP]
PU SETPOS LIST :YAXIS.POS 0 PD
WRAP SETHEADING 0 FD 240 WINDOW
END

TO CHOOSE.TYPE
LINEFEED 18 PRINT [CHOOSE COORDINATE SYSTEM.]
TEXTSCREEN
SPACE 5 PRINT [(1) RECTANGULAR, PLOT POINTS ONLY]
SPACE 5 PRINT [(2) RECTANGULAR, CONNECT POINTS]
SPACE 5 PRINT [(3) POLAR, PLOT POINTS ONLY]
SPACE 5 PRINT [(4) POLAR, CONNECT POINTS]
MAKE "TYPE READCHAR
IF OR :TYPE = "1 :TYPE = 2 [ENTER.FUNCTION STOP]
IF OR :TYPE = "3 :TYPE = 4 [ENTER.P.FUNCTION STOP]
CHOOSE.TYPE
END

TO ENTER.FUNCTION
LINEFEED 1 PRINT [ENTER THE FUNCTION TO BE GRAPHED.]
LINEFEED 1 TYPE [F(X) = ]
MAKE "FUNCTION READLIST
GRAPH.FUNCTION -139
END

TO X
OUTPUT :X
END

TO ENTER.P.FUNCTION
LINEFEED 1 PRINT [ENTER IN THE FORM U V WITH U < V THE]
PRINT [INTERVAL OF ANGLE CHANGE OVER WHICH]
PRINT [YOU WISH TO GRAPH.]
MAKE "INTERVAL READLIST
MAKE "U FIRST :INTERVAL
MAKE "V LAST :INTERVAL
IF NOT :U < :V [ENTER.P.FUNCTION STOP]
LINEFEED 1 PRINT [ENTER THE POLAR FUNCTION TO BE GRAPHED.]
LINEFEED 1 TYPE [R(X) = ]
MAKE "FUNCTION READLIST
GRAPH.P.FUNCTION :U
END

TO GRAPH.FUNCTION :XPOINT
IF :XPOINT > 139 [PRINT CHAR 7 GRAPH.ANOTHER STOP]
IF :XPOINT = -139 [PU]
MAKE "X ((:B - :A) * :XPOINT + 139 * (:A + :B)) / 278
SETCURSOR LIST 0 LAST CURSOR
TYPE [ABSCISSA ] TYPE :X
CATCH "ERROR [PLOT.POINT]
GRAPH.FUNCTION :XPOINT + 1
END

TO PLOT.POINT
MAKE "FX :RATIO * RUN :FUNCTION
MAKE "YPOINT (278 * :FX / (:B - :A)) + :XAXIS.POS
SETCURSOR LIST 20 LAST CURSOR
TYPE [ORDINATE ] PRINT :FX
IF :TYPE = 1 [DOT LIST :XPOINT :YPOINT PD STOP]
SETPOS LIST :XPOINT :YPOINT PD
END

TO GRAPH.P.FUNCTION :ANGLE
IF :ANGLE > :V [PRINT CHAR 7 GRAPH.ANOTHER STOP]
IF :ANGLE = :U [PU]
MAKE "X :ANGLE * PI / 180
SETCURSOR LIST 0 LAST CURSOR
TYPE :ANGLE
SETCURSOR LIST 4 LAST CURSOR
TYPE [DEGREES]
CATCH "ERROR [PLOT.P.POINT]
GRAPH.P.FUNCTION :ANGLE + 1
END

TO PLOT.P.POINT
MAKE "RX RUN :FUNCTION
MAKE "R 278 * :RX / (:B - :A)
MAKE "XPOINT :R * (COS :ANGLE) + :YAXIS.POS
MAKE "YPOINT :RATIO * :R * (SIN :ANGLE) + :XAXIS.POS
SETCURSOR LIST 20 LAST CURSOR
TYPE [R = ] PRINT :RX
IF :TYPE = 3 [DOT LIST :XPOINT :YPOINT PD STOP]
SETPOS LIST :XPOINT :YPOINT PD
END

TO GRAPH.ANOTHER
LINEFEED 2 PRINT [GRAPH ANOTHER FUNCTION (Y/N)?]
MAKE "ANS READCHAR
IF :ANS = "Y [CHOOSE.TYPE STOP]
IF NOT :ANS = "N [GRAPH.ANOTHER]
END

TO PRINT.GRAPH
LINEFEED 2 PRINT [DO YOU WANT A PRINTED COPY (Y/N)?]
MAKE "ANS READCHAR
IF :ANS = "N [STOP] [IF NOT :ANS = "Y [PRINT.GRAPH STOP]]
.DEPOSIT 47299 6
.DEPOSIT 47365 5
LINEFEED 1 PRINT [TURN ON PRINTER AND POSITION PAPER.]
PRINT [THEN PRESS ANY KEY TO CONTINUE.]
MAKE "THROW.AWAY READCHAR
.PRINTER 1
LINEFEED 10
TYPE CHAR 9 TYPE "26H
TYPE CHAR 9 TYPE "E
.PRINTER 0
END

TO PI
OUTPUT 3.14159
END

TO SINR :X
OUTPUT SIN (:X * 180 / PI)
END

TO COSR :X
OUTPUT COS (:X * 180 / PI)
END
```

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Coconuts of Diophantus

A computer solution of a classic problem

Carl J. Patterson

Illustration by Peter Kelley with MacPaint and Thunderscan

One of the more delightful aspects of computing is that it can be an artful blend of analytical problem formulation and elegant number crunching. A clear illustration is given in the famous problem of the castaways and the coconuts. There are many variations of the problem, and I shall present here a representative version and a general algorithm to solve it.

Coconut Problem

Five men were stranded on a desert island where the only food they could find was coconuts. These were gathered all day, and by nightfall the men were so tired that, rather than eating, they decided to wait till the next day to split up the coconut feast. The most suspicious member of the lot arose after he was certain his fellows were asleep and divided the pile of coconuts into five equal shares, took his share and hid it. To conceal his act he pushed the other shares back into one large pile. But lo, a single coconut remained. This one he gave to the only other being the men had found on the island, a monkey. One by one, (in order of how suspicious each was), the other men arose and repeated the actions of the first man, each giving a single remaining coconut to the monkey. (The monkey learned quite quickly to stay around as each man arose.)

Upon arising the next day the pile of coconuts was divided into five equal shares, but the monkey was disappointed: there was no coconut remaining. Our problem is to find out just how many coconuts there were and how many each man got.

Formulate

OK, hackers, don't start writing code just because you can visualize a couple of FOR loops to get you started. Instead try making some observations about the problem. For example, the solution requires integers (the men didn't have a machete with which to make fractional coconuts).

Another observation: maybe the solution isn't unique, so we should look for the smallest number that satisfies the problem. Next, one might consider how the problem should be formulated: by congruences (for number theorists); by trial and error (for hardcore computerists); or by considering steps taken in the course of the problem and carrying them, by pencil and paper, as far as they will lead. This last approach is the method we shall use.

If there were X coconuts at the beginning, it is clear that after the first man took his share, 4/5(X–1) coconuts remained. This remaining amount becomes a new X for the second man. If we call this X′, then after the second man takes his share there remain 4/5(X′–1) or 4/5 (4/5(X–1)–1) coconuts. If we continue in this manner we will generate the information in Table 1.

Because the men were able to divide the remaining coconuts evenly in the morning, we know that the last expression is divisible by 5. So with a little algebra we determine that

$$(4/5)^5 X - 4(1-(4/5)^5 = 5Y$$

The term 5Y expresses the divisibility of the righthand side by 5. Also, since the righthand side of the equation represents a number and the 5 in the lefthand side represents the number of men, Y represents the number of coconuts per man in the final division of coconuts. Simplifying the above equation a bit

$$1024\,X - 15625\,Y = 8404$$

with X, the original number of coconuts,

Man	Remaining Coconuts
1	4/5 (X–1)
2	4/5 (4/5 (X–1) –1)
3	4/5 (4/5 (4/5 (X–1) –1) –1)
4	4/5 (4/5 (4/5 (4/5 (X–1) –1) –1) –1)
5	4/5 (4/5 (4/5 (4/5 (4/5 (X–1) –1) –1) –1) –1)

Table 1.

Man	Early Share	End Share	Total Share
1	624	204	828
2	499	204	703
3	399	204	603
4	319	204	523
5	255	204	459

Table 2.

and Y, the number each man gets in the final division, both being integers.

Solve It

Rather than a trial and error or brute force technique, I wrote a program to solve the problem based on Diophantine analysis. In particular, the algorithm the program uses is based on continued fractions. The program can handle equations of the form

$$AX + BY = C \text{ or } AX - BY = C$$

with minor restrictions on A, B, and C. The program listing offers a bit of explanation, but for now it suffices to say that the second alternative is selected by inputting a problem type of 0. The variables A, B, and C are given by 1024, 15625, and 8404, respectively. The answer is given by

$$X = 91174996 + t\ 15625 \text{ and}$$
$$Y = 5975244 + t\ 1024$$

where t is any integer, including negative. If this seems to imply that there is an infinite number of solutions, there is. For all equations of this form there is either an infinite number of solutions or there is none, and the program is capable of informing you if there is none. To find the smallest number of coconuts that satisfies the problem, we look for t to satisfy

$$t > -91174996/15625 = -5835.2$$

and

$$t > -5975244/1024 = -5835.2.$$

Picking t equal to 5835 and using it in the expression for X and Y we get, X = 3121 and Y = 204. So originally there were 3121 coconuts.

Solve It Completely

To complete the solution, the first man received 1/5 (3121 – 1) or 624 coconuts plus the 204 he received in the final division, or 828 coconuts. The second man received 1/5 (4/5 (3121 – 1)) or 499, plus 204 for 703 coconuts. If we continue like this, we generate the information in Table 2.

For those of you who added up the column under total share and noticed the total was only 3116, don't forget the monkey, who got five coconuts, bringing the total to 3121.

Keep Going

The problem is now completely solved, and its formulation as well as its solution affords pleasurable musings. You may wish to look at variations on the theme—more men or more monkeys, for example. If the problem is properly formulated, the program should be able to handle these versions also.

The program is written in DEC's Basic Plus, but I tried not to use too many implementation-dependent features. Two sections, with line numbers 960 to 1010 and line numbers 1080 to 1150 were necessary because integers are limited to 32,768 on the system I was using. The function NUM1$(X) is a system function that takes the numeric value of X and makes a string containing numerals that represent that value. The function PROD$ takes the product of its first two arguments, which must be strings, and returns a string with the number of significant places determined by its third argument. ■

Diophantine Analysis Program Listing.

```
100       DIM R%(100)
110       DEF FNM(A%,B%)=A%-INT(A%/B%)*B%
120 REM
130 REM written by Carl J Patterson of DEC.
140 REM
150       PRINT
160       PRINT "Would you like an explanation of the type of"
170       INPUT "problems this program can solve ";R$
180       IF LEFT("NO",LEN(R$)) = R$  THEN GOTO 310
190       PRINT
200       PRINT " This program can solve linear Diophatine equations,"
\         PRINT "ie. equations of the form, A * X  + B * Y = C, or"
\         PRINT "A * X - B * Y = C, where A, B, and C are given integers"
210       PRINT "and the solution (X,Y) is also in the integers, for"
\         PRINT "example 2*X + 3*Y = 7, with solution X = 2, and Y = 1."
220       PRINT
\         PRINT " The only constraints are:"
\         PRINT "  1) A must be positive, it can be made so by multiplying"
\         PRINT "     the equation by -1,  and"
230       PRINT "  2) The greatest common divisor of A and B must divide"
\         PRINT "     C, otherwise no solutions exist, see references."
240       PRINT
250       PRINT"The program will resolve these difficulties, if possible."
260       PRINT
270       PRINT
280       PRINT "Given the constraints are satisfied an infinite number"
\         PRINT "of solutions exist.  The program will give their general form."
290       PRINT
300       PRINT " References :"
\         PRINT "          Continued Fractions - C. D. Olds."
\         PRINT " Recreations in the Theory of Numbers - Beiller."
310       PRINT
320       INPUT "Do you need an explanation of the possible choices ";R$
330       IF LEFT("NO",LEN(R$))= R$ GOTO 380
340       PRINT
350       PRINT "To solve an equation of the form A*X + B*Y = C"
\         PRINT "input 1 as the problem type, followed by the"
\         PRINT "values for A, B, and C."
360       PRINT
370       PRINT "To solve an equation of the form A*X - B*Y = C"
\         PRINT "input 0 for the problem type, followed by the "
\         PRINT "values for A, B, and C."
380       PRINT
390       PRINT
400       INPUT "Enter problem type and coefficient values. ";T%,A%,B%,C%
410       IF A%>0% THEN GOTO 430
420        A% = - A%  :  B% = - B%  :  C% = - C%
430       IF B%>0% THEN GOTO 450
440        T% = 1% - T%  :  B% = - B%
450       A1%=A%
460       B1%=B%
470 REM
480 REM Now find the continued fraction expansion of A%/B%
490 REM
500       I%=0
510         I%=I%+1%
520         R%(I%)=INT(A1%/B1%)
530         M%=FNM(A1%,B1%)
540         A1%=B1%
550         B1%=M%
560       GOTO 510 UNLESS B1%=0
570       IF A1%=1 THEN GOTO 660
580        IF C%=(C%/A1%) * A1% THEN GOTO 620
590         PRINT
600         PRINT "There is no solution to this problem."
\           PRINT "One side of then equation is divisible by ";A1%
\           PRINT "and the other side isn't."
610         GOTO 1300
620 REM
\   REM Divide A%, B%, and C% through by the GCD of A% and B%.
630 REM
640         A%=A%/A1%  : B%=B%/A1%  : C%=C%/A1%
650         GOTO 410
```

Diophantine Analysis Program Listing. *(continued)*

```
660       IF FNM(I%,2%)=0 AND C%>0 THEN 730
665       IF I%=1 THEN 730
670       IF FNM(I%,2%)=1 AND C%<0 THEN 730
680        IF R%(I%)<>1 THEN GOTO 710
690         R%(I%-1)=R%(I%-1) + 1
\           R%(I%)=0
\           I%=I%-1
700        GOTO 730
710         R%(I%)=R%(I%) - 1
\           R%(I%+1)=1
\           I%=I% + 1
720 REM
730 REM We now have the correct dimension of the continued
740 REM fraction for the type of problem. See references.
750 REM
760       P1%=R%(1%)
\         Q1%=1%
\         P2%=R%(2%)*R%(1%) + 1%
\         Q2%=R%(2%)
765       IF I%=1 THEN Q0%=Q1%
770       IF I%=2% THEN P0%=P1%
\                       Q0%=Q1%
\                 GO TO 860
780       IF I%=3% THEN P0%=P2%
\                       Q0%=Q2%
\                 GO TO 860
790       FOR N%=3% TO I%-1%
800         P0%=R%(N%)*P2% + P1%
810         Q0%=R%(N%)*Q2% + Q1%
820         P1%=P2%
\           Q1%=Q2%
830         P2%=P0%
\           Q2%=Q0%
840       NEXT N%
850 REM
860 REM We now have all elements of the solution, ie. the
870 REM values of the numerator and denominator of the
880 REM conversent.  See references.
890 REM
900       C=C% : U0=Q0% : P0=P0%
910       IF ABS(C*Q0)>=32768 OR ABS(C*P0)>=32768 THEN GOTO 960
920       IF T%=1 THEN GOTO 950
930         X%=ABS(C%)*Q0%
\           Y%=ABS(C%)*P0%
940        GOTO 1040
950         X%=ABS(C%)*Q0%
\           Y%=-ABS(C%)*P0%
960       IF C*Q0=0 OR C*P0=0 THEN IX%=2
\                                  IY%=2
\                           GOTO 970
965         IX%=2+INT(LOG10(C*Q0)) : IY%=2+INT(LOG10(C*P0))
970       IF T%=1% THEN GOTO 1000
980         X$=PROD$(NUM1$(ABS(C%)),NUM1$(Q0%),IX%)
990         Y$=PROD$(NUM1$(ABS(C%)),NUM1$(P0%),IY%)
\           GOTO 1020
1000      X$=PROD$(NUM1$(ABS(C%)),NUM1$(Q0%),IX%)
1010      Y$=PROD$(NUM1$(-ABS(C%)),NUM1$(P0%),IY%)
1020 REM
1030 REM
1040 REM Print results, including the general solution
1050 REM
1060      PRINT
1070      T$=" t *"
\         T1$=" - t *"
1080      IF ABS(C*Q0)<32768 AND ABS(C*P0)<32768 THEN GOTO 1190
1090      IF T%=0% THEN GOTO 1130
1100        PRINT "Solution :  X = ";X$;T1$;B%
1110        PRINT "            Y = ";Y$;" +";T$;A%
1120       GOTO 1150
1130        PRINT "Solution :  X = ";X$;" +";T$;B%
1140        PRINT "            Y = ";Y$;" +";T$;A%
1150      GO TO 1250
1160 REM
1170 REM We had to do this because of integer size limitations
1180 REM
1190      IF T%=0 THEN GOTO 1230
1200        PRINT "Solution :  X = ";X%;T1$;B%
1210        PRINT "            Y = ";Y%;" +";T$;A%
1220       GOTO 1250
1230        PRINT "Solution :  X = ";X%;" +";T$;B%
1240        PRINT "            Y = ";Y%;" +";T$;A%
1250      PRINT
1260      PRINT " Where  the variable t represents any integer."
1270      PRINT
1280      INPUT " Do you have another problem ";R$
1290      IF LEFT("YES",LEN(R$)) = R$ THEN GOTO 310
1300      END
```

TANDY GRAM

News from the top: What's really going on at Tandy/**Ed Juge**

This month, Tandy Gram features a special guest columnist, Ed Juge, director of market planning at Tandy. We asked him to write about the future of the company and its machines—not only the new ones, but the old standbys as well. His report should be heartening to TRS-80 owners of all persuasions. Jake Commander will return next month.

One of the great joys and consuming passions of our industry seems to be the incredibly prolific rumor mill. The entertainment value would be hard to deny. However, when you have made—or are about to make—a big investment, it is reassuring to be able to separate fact from fiction. I guess that's why the editors asked me to sit in this month and discuss Tandy Corporation/Radio Shack computers and computer directions. Since our rumor mill is one of the most active (or so it seems to us), I didn't require much persuading.

Our entry into the MS-DOS market in 1983 with the Tandy 2000 and last year's expansion of that line with the Tandy 1000 and 1200HD has received quite a bit of attention. The 1000 has set sales records for us from the day it was introduced. Recently, we announced very aggressive MS-DOS product pricing. Tandy's intention to be a leader in this portion of the market is obvious. It is important to say that we consider the 1200HD our only IBM "clone."

Our strategy is to continue as the price/performance leader, but also to bring something extra to the table with our offerings. With the Tandy 2000, it was ultra-high performance in a single-user MS-DOS machine (notice I didn't say "compatible" . . . we said from Day One it wasn't). Today, in the single-user market, the performance of the 2000 is about equal to that of the IBM PC AT, which sells for more than twice the price. The 1000 offers full IBM PC compatibility, plus enhanced graphics and sound, and a smaller footprint, and has most of the "common" extras built in. And we have announced for the 1000, 1200HD, and 2000 VIANET, the only available network that does not require you to dedicate one machine as a system fileserver.

The 1000 has set sales records for us from the day it was introduced.

Our future direction will be to leverage from the software standard and the growing software library created for the IBM PC, rather than produce "me-too" products.

Concern is often expressed over the future of our "older" products, so let me say that the Tandy 2000 will remain in our line for the foreseeable future. We have more than 120 software packages available for it in our private labeled and Express Order software lines. That includes almost all of the IBM PC top 50. And the selection continues to grow.

A Future for "Older" Machines

Where does MS-DOS leave our other computers? Of most concern, because of the huge installed base, is the Model 4. True, we have pared down the line, dropping the cassette, transportable, and single-disk versions. With the falling price of the dual-disk model, sales of the cassette and single-disk units had slowed. And even though you won't find a more enthusiastic and devoted group of owners than our Model 4P folks, transportables just weren't moving well for any company that also sold a desktop version. The dual-disk unit should continue until the marketplace tells us it is no longer a product.

Several factors are at work here: TRSDOS 6 is an outstanding operating system. (An admittedly prejudiced mainframe programmer said to me just yesterday, "It's the only *real* operating system on a micro today.") And there is a tremendous base of mature, proven TRSDOS and CP/M software available for a wide variety of tasks. The 4 is still a very cost-effective computer, and extremely popular with schools. If we were going to drop it, would we be introducing a new double-sided drive version this fall?

Color Computer owners are concerned, now that the Tandy 1000 is the first fully IBM PC-compatible computer available for less than $1000. Where will that leave the CoCo? I can't deny that some customers who last year might have bought a 64K disk CoCo system with all the trimmings are now choosing the 1000. But there are still many, many folks who don't want to plunk down that kind of cash all at once. They want a machine that allows them to start small and build.

No home computer on the market today has the potential horsepower of the Color Computer. Coupled with disks and a sophisticated operating system, it can handle multi-tasking and even multi-user operation. Try that with your Commodore 64. So, we believe the CoCo also has a good future, even though it may share some of it's "high end" buyers with the Tandy 1000.

In lap portables, we still seem to be the leader. We have been accused by our competition of producing niche machines, because they are not *high horsepower PC-compatibles*. From sales estimates I have seen, our niche must be a pretty large one! As we suspected, not too many people have need for heavy, bulky, expensive PC-compatible portables. The marketplace isn't as big as we had hoped, but we seem to have tapped what there is better than anyone. Even in competition with the PC-compatibles, our Tandy 200 is moving quite well. And to squelch another rumor: there is *not* a Tandy MS-DOS portable "in the chute" at this time.

At the upper end of our line is the Tandy 6000. It is reported to be the Unix/Xenix market share leader. And that includes micro, mini, and mainframe machines. The 6000 is twice as fast as the 16/16B that made us the leader, and the 6000 is without a doubt the market price/performance leader. This summer, we'll have our VIANET local area network available for the 6000.

Software is the name of the game today. That is really the attraction of MS-DOS: most of the really exciting programs have been developed there first. Maybe that realization has struck Mac owners after the fascination of gee-whiz icons and mice has worn thin. So, what directions will Tandy be taking?

New Directions

As you know, we have an in-house programming staff. They support all of our private-labeled software, regardless of how we acquire it. They support the operating systems, languages, and utilities. But most of our applications software is now written by third parties.

Scripsit is a Tandy product, as is the new *Quartet* accounting package, and *DeskMate*. So, we will be doing some exclusive in-house packages when there is a reason, but we intend to rely mostly on "big-name," market proven software from leading software firms.

No home computer on the market today has the potential horsepower of the Color Computer.

The universal problem of software support is making our Express Order software program very attractive and successful. There is a limit to the number of programs our staff can adequately support. In the field, we have addressed the problem with our new Area Training and Support Operations (ATSO) which provides groups of specialists in major areas to answer questions and provide optional consulting services. But there are still limits. So through Express Order, support is furnished by the folks who know the system best, the authors or publishers. We are actively expanding that program. And we are getting demonstration disks in Computer Centers for as many EOS offerings as we can.

Tandy and Radio Shack's overall direction and goal is to provide the best value available in hardware and software solutions and to back them up with clearly superior service and support. I think we are well positioned with the best, most complete line of PCs in the industry. There is no question that our ATSOs and Business Products Service Centers (providing faster service and often even while-you-wait walk-in service), are solving the industry-wide support problems that the competition is still only talking about. We are serious about computers, and we are absolutely long-term players. We intend to be around after the "shakeout" to take care of our present and future customers. ■

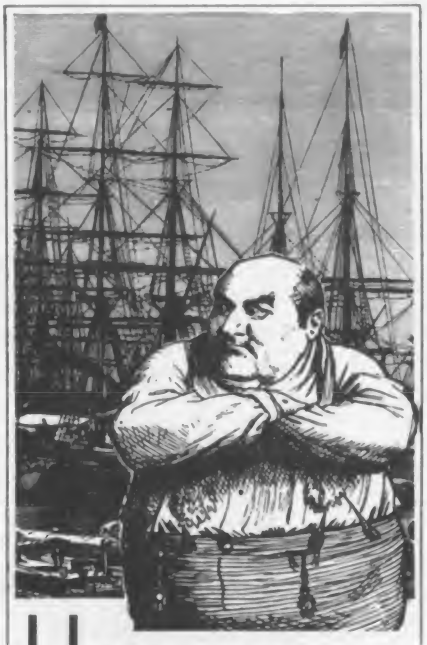
COMMODORE'S PORT

Auto boot and redefined function keys for the C128/**Sheldon Leemon**

Oh the dangers of lead time: Here I am in late July, writing a column for the October issue, having read in John Anderson's August Commodore's Port column that the 128 is currently in distribution. But it is not. Various explanations have been offered but none by Commodore. One clue is that the demonstration model I received in late June looks like a production version, but if you turn it over, instead of an FCC sticker on the bottom of the case, there is a warning label that the unit has not been FCC certified and is not for sale until clearance has been obtained.

Of course, now that I am writing about the delay, you can bet that by the time you read this, the 128 will be shipping, making the whole question moot. It is a well-known effect, like washing your car to make it rain. So if you have your 128 by now, you have me to thank for putting an end to the delay. The delay does illustrate an important change at Commodore, however.

Under the Tramiel regime, the Commodore philosophy was "we will ship no computer before we get paid for it." The new management apparently agrees more with Paul Masson and will ship no computer before its time. That is good news in the long run for the consumer, who is really better off waiting a little longer to get a machine that works right the first time.



Under the Tramiel regime, the Commodore philosophy was "we will ship no computer before we get paid for it."

C128 Function Keys

This slight delay also works to the benefit of columnists, who have had time to stockpile material about the 128. In this column I will share a couple of tidbits that I have unearthed already. The first item of interest regards the programmable function keys. Basic 7.0 includes the KEY command, which allows you to assign text strings to be printed whenever the function keys are pressed. There are defaults set up every time you turn the computer on, so that pressing the F3 key, for example, prints the keyword DIRECTORY plus a carriage return that enters the command, which then prints a disk directory. You can get a list of these defaults simply by typing the KEY command. But you aren't stuck with Commodore's choices for these keys. You can also use the KEY command to change the values of the text strings.

The F1 key, for example, prints the keyword GRAPHIC. That is not a command I am likely to use every time I sit down at the keyboard. Entering the statement:

```
KEY 1,"?DS$"+CHR$(13)
```

will set up the F1 key so that every time I press it, the disk error channel will be read and the error message displayed. Notice that CHR$(13), the carriage return character, was added to the end of the string to enter the command after it has been printed. Using the concatenation operator (that's computer talk for the + sign), we can add any of those little CHR$ characters that we want to our function key string.

For example, if you wanted a function key to clear the screen first and then display the directory, you could enter:

```
KEY 3,"?CHR$(147):
    DIRECTORY"+CHR$(13)
```

Two functions on the same key. Not bad!

On the 128, the text for these messages is stored in RAM (Bank 0), from locations 4096 to 4351. The binary save and load commands (BSAVE and BLOAD) make it easy to save all of your key definitions to disk and load them back in all at once, instead of having to type them one by one with the KEY command.

"So what?" you may be asking yourself. After all, you can accomplish the same thing by creating a Basic program that sets up all of your favorite key definitions with the KEY command. Then you can run it when you want to change all of the definitions at once.

But if you use the machine language monitor, you will discover something very interesting (you can get into the monitor, by the way, by pressing the F8 key). Type 'M 1000' and the monitor will display the text characters that are invoked by the function keys on the right side of the screen. If you look at the last couple of strings, you will find that the text printed by the SHIFT-RUN/STOP combination and the HELP key is also stored there. So actually, there are ten user-definable keys, even though the KEY command lets you change only the first eight.

How do you change the text strings assigned to the HELP key and the SHIFT-RUN/STOP? Well, you must know a little bit about how the text for these keys is stored. The function key storage area begins at location 4096 in Bank 0. The first ten bytes hold the lengths of each of the ten text strings. The actual text itself follows at location 4106. When the keyboard editor sees that one of the definable keys has been pressed, it uses the length bytes to determine where to start and stop printing text.

So, to redefine the two "extra" function keys, we have to POKE in the text for these two keys after the end of the text for the other eight and then change the length bytes at locations 4104 and 4105 to reflect the lengths of these two strings. And you thought that Basic 7.0 would eliminate all POKEs!

The short Basic program in Listing 1 shows how to redefine the two keys, and save all of the key assignments to a disk file name Keydata. Then, if you want to read in all ten of your new key

Listing 1.

```
10 HE$ = "NO HELP FOR YOU!" +CHR$(17) +CHR$(13)
20 SR$ = "OUCH!" +CHR$(17) +CHR$(13)
30 T$ = SR$ + HE$
40 FOR A=0 TO 7: B= B +PEEK (4096 +A) :NEXT
50 BANK 0: POKE 4104, LEN (SR$)
60 POKE 4105, LEN (HE$)
70 FOR A =1 TO LEN (T$): POKE 4105 +B +A, ASC (MID$ (T$,A,1):
NEXT
80 SCRATCH "KEYDATA": BSAVE "KEYDATA", B0, P4096 TO P4351
```

Listing 2.

```
10 h$="cbm" +chr$(0) +chr$(0) +chr$(0) +chr$(0) +chr$(0) +chr$(0)
20 for x =1 to 14: read a$: h$= h$ +chr$ (dec (a$) ):next
30 read a$, b$: h$ =h$ +a$ +chr$(34) +b$ +chr$(13)
40 open 15,8,15: dopen 2,8,2,"#"
50 print#15, "b-p";2;0: print#2, h$
60 print#15, "b-a";0;1;0
70 print#15, "u2";2;0;1;0: dclose
80 data a2, 0a, 86, c0, bd, 16, 0b
90 data 9d, 49, 03, ca, d0, f7, 60
100 data "rU": rem r-(shift-u)
110 data "auto "
```

definitions at once, you just BLOAD "KEYDATA", B0, P4096.

Run the program, then press the HELP key. Get the idea? Whatever appears in HE$ in line 10 is printed by the HELP key, and whatever appears in RS$ in line 20 is printed by the SHIFT-RUN/STOP combination. You probably will want to set SHIFT-RUN/STOP to something like its default "RUN"+CHR$(34)+"*"+CHR$(13), so that it will still load and run the first program on the disk. But since the HELP command is not really all that helpful, redefining it is like getting an extra function key for free.

Auto Boot for the C128

For my next number, I'm going to play a request. As John has mentioned in earlier columns, the 128 operating system tries to boot the disk on power up. This means that it reads the disk drive, and if it finds some special data on track 1, sector 0, it reads a machine language program from that sector and executes it. By placing on that sector a machine language program that runs a named file from the disk, you can get the 128 to load and run a Basic program automatically when you turn it on. If you happen to have a four-year-old, as I do, this means that you don't have to wait until he is old enough to type LOAD "*",8 and RUN before you can let him use the computer. It is even handy for those of us over four.

And contrary to popular belief, it works in 128 mode as well as CP/M mode, and it works on the 1541 as well as on the 1741.

When it came to actually writing the boot sector code, however, John hedged. Since he is a new father, I appreciate the time constraints under which he now operates so, as a personal favor to him, I wrote the program in Listing 2 to "create" a 128 boot disk. I have listed it in lowercase, so that you can clearly see that the character at the end of the string in line 100 is a shifted U (R-SHIFT-U is the abbreviation for the Basic keyword RUN).

Because the program writes directly to the disk, some caution is indicated. First, type in the program and save it to disk. *Do not* run the program while the disk to which you have saved it is still in the drive. Instead, get out a brand new disk. Format it with the HEADER command. When you list the directory, you should have 664 blocks free. Now, keep this new disk in the drive and run the program. After it is done, the directory should indicate that you have 663 blocks free, because one block has been allocated to the boot sector. Now, all that remains is to save the Basic program you want to have run automatically to the same disk. For demonstration purposes, type NEW, then enter the program:

```
10 PRINT CHR$(147)
   "EUREKA! IT WORKS"
```

Enter the command DSAVE "AUTO. Now you are ready for the acid text. Press the reset button on the right side of the 128. If all goes well, after the Commodore Basic 7.0 sign-on message comes on, you will see:

```
BOOTING . . .
rU"auto
```

and the program will run. If not, you will just have to take my word that it works.

The name of the program appears in the DATA statement in line 110. Feel free to replace it with the filename of your choice. Just remember that because only ten characters can be placed in the keyboard buffer at once, you are limited to six characters in the filename. If the name has fewer than six characters, add extra spaces at the end of the name to make exactly six characters as was done above. Also remember that for the boot to work, you must have a program with that name located on the same disk.

What about the 64 side of the computer? Is it possible to boot a machine language program that changes the computer to the 64 mode and then automatically loads and runs a Basic program? At first, I thought not, because once you switch to the 64 mode, you lose control completely (so to speak). I have discovered a way to perform even this seemingly-impossible task, however. Unfortunately, I have run out of space. How many marvels do you expect in one column, for goodness sake? With Mr. Anderson's indulgence, however, I will make another guest appearance at a future date to reveal this and other interesting tidbits. (*Sounds like he's hedging, doesn't it?—JJA*) ■

"Thank you for calling Acme Systems. We have the world's largest CPU and two hundred disk drives—none of which are available at the moment."

OUTPOST: ATARI

Font upgrade revisited; full screen graphics in Mode 7+

Richard Whitsell

In the July Outpost, John Anderson created a program that changed the Atari default character set into a more pleasant, more readable character set. From that beginning, I developed some improved code that installs the font, making it the default character set at boot time, in AUTORUN.SYS file format.Complete instructions are to be found in the program itself, which appears as Listing 1.

Of course, to make a successful installation you must also have a copy of John's original program. For an introduction to character sets, take a look at the January 1982 Outpost column.

Full Screen Graphics in Mode 7+

Listing 2 is a subroutine utility that will set up a GR.7+ screen and allow you to create a 160 x 192 GR.7+ screen and to plot or draw lines in the entire available screen area.

To plot or draw a line, you must have your X and Y coordinates stored in the variables XP and YP. To plot a point, you then must GOSUB to line 30000. To draw a line, you should GOSUB 31000.

To set up the GR.7+ screen, all 54 values in the DATA statements can be put in a string, or page 6, or wherever else you might like, and called up with a USR statement. The routine will change only a GR.8 screen to GR.7+, so make sure that you issue a GR.8 or GR.8+16 command before invoking the USR call.

Listing 3 is a sample program that creates an interesting full-screen display on the GR.7+ screen. Simply enter this program along with Listing 2, and you are up and running.

I hope you enjoy exploring these programs as much as I enjoyed putting them together for you. For those who want to avoid typing drudgery, the three of them are available for download through Creative Computing Online, via CompuServe (type GO CRE). I first "met" John Anderson there, and find that the Online arm of *Creative* is at least as exciting as the print version. You can easily get in touch with either of us on CompuServe. My ID is 75056,1527, and John's is 76703,654. Please feel free to send us your comments, improvements, and new ideas. So long now, and catch you online. ■

Listing 1.

```
4000 REM *
4010 REM * INSTALL.UPG
4020 REM * by Rich Whitsell
4030 REM *
4040 REM *   This program will create
4050 REM * a program which will load
4060 REM * John Anderson's new
4070 REM * character font upon
4080 REM * loading.
4090 REM *   All you do is ENTER this
4100 REM * program after FONT.UPG
4110 REM * is loaded.  After the
4120 REM * first program runs, this
4130 REM * program will create a
4140 REM * file on your disk called
4150 REM * FONT.SYS, which you can
4160 REM * rename to AUTORUN.SYS.
4170 REM *   When you call up the DOS
4180 REM * menu, the routines that
4190 REM * handle RESET and other
4200 REM * functions are erased, so
4210 REM * RESET and the character
4220 REM * set are set to default.
4230 REM * To get the new font back,
4240 REM * you have to re-boot.  On
4250 REM * programs such as Atari-
4260 REM * Writer you won't need to,
4270 REM * of course.
4280 REM *   If you hold down the
4290 REM * START button while press-
4300 REM * ing RESET, the default
4310 REM * character set is put back.
4320 REM *   If you have any problems
4330 REM * or questions, drop me a
4340 REM * line on CompuServe.  My
4350 REM * ID is 75056,1527
4360 REM *
5000 ? "PRESS START TO MAKE FONT.SYS"
5010 IF PEEK(53279)<>6 THEN 5010
5020 OPEN #1,8,0,"D:FONT.SYS"
5030 RESTORE 10000
5040 FOR X=0 TO 5:READ V:PUT #1,V:NEXT X
5050 FOR X=0 TO 95:READ V:PUT #1,V:NEXT X
5060 FOR X=96 TO 255:PUT #1,0:NEXT X
5070 CBASE=PEEK(756)*256
5080 FOR X=CBASE TO CBASE+1023
5090 V=PEEK(X):PUT #1,V:NEXT X
5100 PUT #1,224:PUT #1,2
5110 PUT #1,225:PUT #1,2
5120 PUT #1,0:PUT #1,31
5130 CLOSE #1
5140 ? "FONT.SYS IS NOW ON THE DISK"
10000 DATA 255,255,0,31,255,35
10010 DATA 165,10,141,93,31,165,11,141
10020 DATA 94,31,165,12,141,57,31,165
10030 DATA 13,141,58,31,169,77,133,10
10040 DATA 169,31,133,11,169,56,133,12
10050 DATA 169,31,133,13,169,0,133,128
10060 DATA 141,231,2,169,36,133,129,141
10070 DATA 232,2,169,32,141,244,2,96
10080 DATA 32,64,21,32,20,31,162,32
10090 DATA 173,31,208,201,6,208,2,162
10100 DATA 224,142,244,2,96,169,224,141
10110 DATA 244,2,173,57,31,133,12,173
10120 DATA 58,31,133,13,76,0,0,0
```

Listing 2.

```
30000 REM ** PLOT (XP,YP) ROUTINE
30010 IF YP)95 THEN 30030
30020 PLOT XP,YP:AP=XP:BP=YP:RETURN
30030 DMH=PEEK(89):POKE 89,DMH+15
30040 PLOT XP,YP-96:AP=XP:BP=YP
30050 POKE 89,DMH:RETURN
30999 REM
31000 REM ** DRAWTO (XP,YP) ROUTINE
31010 IF BP)95 THEN 31500
31020 IF YP)95 THEN 32000
31030 SWITCH=0
31040 IF SWITCH THEN DMH=PEEK(89):POKE 89,
      DMH+15
31050 IF SWITCH THEN BP=BP-96:YP=YP-96
31060 PLOT AP,BP:DRAWTO XP,YP
31070 IF SWITCH THEN BP=BP+96:YP=YP+96
31080 POKE 89,DMH
31090 AP=XP:BP=YP:RETURN
31500 IF YP)95 THEN SWITCH=1:GOTO 31040
31510 DMH=PEEK(89):POKE 89,DMH+15
31515 IF XP=AP THEN CHNGA=0:GOTO 31540
31520 SLOPE=(YP-BP)/(XP-AP)
31530 CHNGB=BP-96:CHNGA=CHNGB/SLOPE
31540 PLOT AP,BP-96:DRAWTO AP-CHNGA,0
31550 POKE 89,DMH
31555 IF XP=AP THEN CHNGX=0:GOTO 31570
31560 CHNGY=95-YP:CHNGX=CHNGY/SLOPE
31570 PLOT XP+CHNGX,95:DRAWTO XP,YP
31580 AP=XP:BP=YP:RETURN
32000 IF XP=AP THEN CHNGA=0:GOTO 32020
32005 SLOPE=(YP-BP)/(XP-AP)
32010 CHNGB=95-BP:CHNGA=CHNGB/SLOPE
32020 PLOT AP,BP:DRAWTO AP+CHNGA,95
32030 DMH=PEEK(89):POKE 89,DMH+15
32035 IF XP=AP THEN CHNGX=0:GOTO 32050
32040 CHNGY=YP-96:CHNGX=CHNGY/SLOPE
32050 PLOT XP-CHNGX,0:DRAWTO XP,YP-96
32060 POKE 89,DMH
32070 AP=XP:BP=YP:RETURN
32500 DATA 104,165,87,201,8,240,1,96
32510 DATA 169,7,133,87,173,48,2,133
32520 DATA 203,173,49,2,133,204,160,0
32530 DATA 177,203,201,79,208,10,169,78
32540 DATA 145,203,200,200,200,24,144,240
32550 DATA 201,15,208,4,169,14,145,203
32560 DATA 200,192,199,208,227,96
```

Listing 3.

```
10 RESTORE
20 FOR X=0 TO 53:READ A
30 POKE 1536+X,A:NEXT X
40 GRAPHICS 8+16:X=USR(1536)
50 COLOR 2
60 FOR X=0 TO 159 STEP 3
70 XP=80:YP=96:GOSUB 30000
80 XP=X:YP=0:GOSUB 31000
90 XP=80:YP=96:GOSUB 30000
100 XP=179-X:YP=191:GOSUB 31000
110 NEXT X
120 COLOR 3
130 FOR Y=191 TO 0 STEP -3
140 XP=80:YP=96:GOSUB 30000
150 XP=0:YP=Y:GOSUB 31000
160 XP=80:YP=96:GOSUB 30000
170 XP=159:YP=191-Y:GOSUB 31000
180 NEXT Y:COLOR 1
190 FOR X=0 TO 159 STEP 3
195 XP=X:YP=0:GOSUB 30000
200 XP=159:YP=X*(191/159):GOSUB 31000
210 XP=159-X:YP=191:GOSUB 30000
220 XP=0:YP=(159-X)*(191/159):GOSUB 31000
230 NEXT X
240 GOTO 240
```

IBM IMAGES

The view from Windows/**Will Fastie**

I consider myself lucky to have obtained an early, pre-release copy of Microsoft Windows. Although it has been my normal policy not to review software before it is in final release, I am making an exception for Windows because I so recently covered competing products (IBM's TopView and Digital Research's GEM, in last month's column). I also believe that few significant changes will be made in the basic product before it hits the retail shelves (about the time you read this, according to Microsoft), so I feel confident in telling you about the product. By the way, I asked Microsoft if they had any objections to this early article and they said no, indicating their confidence as well. Microsoft did ask that I keep in mind that there might be changes in the final product; you'll have to bear that in mind, too.

Last month I defined environment as the way in which the operating system presents itself and its functions to the user. I pointed out that TopView and GEM are nothing more than DOS programs, but that they so alter the way the user interacts with the system that they are environments unto themselves. This definition is apt for Microsoft Windows (hereinafter simply Windows); however, this program integrates with DOS much more effectively and much more successfully than either TopView or GEM. At the same time, it is a significant functional extension of DOS and a concurrent environment.

Windows requires an IBM PC or compatible, at least 256K of memory, disk drives, and a graphics display. More memory, a hard disk, and a mouse are optional. Windows is at its best, however, with as much memory as you can give it, a hard disk or, at the very least, a large RAM disk, and a mouse. I am unclear about support for the Lotus/Intel memory spec, but because Windows can take advantage of a RAM disk of any kind, an investment in a memory product in the Above Board genre will not be wasted on Windows. I expect that future upgrades to Windows will allow programs to execute from Lotus/Intel extended memory or the protected memory of the 286 processor, such as is found in the AT.

The graphic display is an absolute requirement, and Windows is obsessive about control in this area. I was unable to run any program in Windows that switched to my monochrome display, a fact that caused me to exit Windows when I was doing extensive textual work. Windows even traps the MODE command! Those are objections to the product, but ones that can be overcome if your PC is equipped with the IBM EGA or the Hercules card. Both offer better performance and monochrome display-like resolution for text, so text work on them is satisfactory. IBM's EGA and CGA, and the Hercules card, are the only graphics devices supported; expect more from Microsoft soon.

A hard disk or larger RAM disk is very important to give Windows the peppy performance that makes using the mouse pointing system effective.

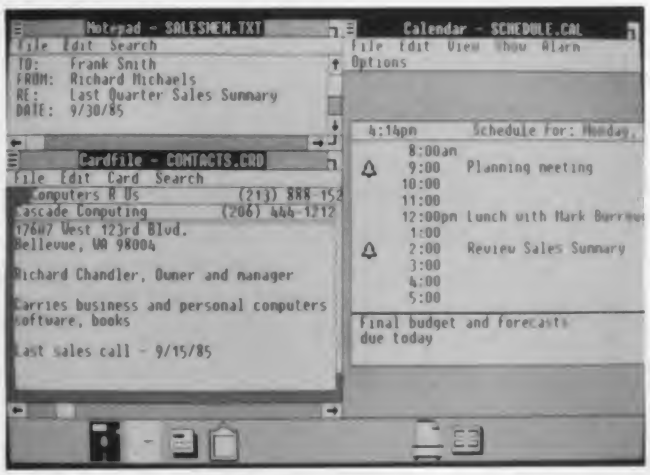
Windows on the IBM CGA or equivalent is surprisingly good in two dimensions. First, it is very fast. The only performance penalty is text scrolling, which is agonizing when compared to the monochrome display. Scrolling is happening as fast as it can; remember that Windows is doing all the character generation itself on a graphical display that it completely manages. Second, the CGA display is very pretty. Windows can display only black and white, but it does so very well, and the higher 640 x 200 resolution provides the necessary clarity.

I have the EGA with extended memory on my office AT. There, Windows looks absolutely gorgeous and can take full advantage of color. Because EGA text is almost as good as monochrome, I stay within Windows all the time. At home, with a dual monochrome and CGA system, I exit Windows to use the word processor. In my case, the important factor is text, not the quality of the graphics presentation. That leads to the question of how to upgrade an existing PC to take advantage of Windows. I suggest the Hercules card, because it is the least expensive way to get higher resolution: you need purchase only the card, not a new display device. There are other monochrome boards on the market, but Microsoft has not announced support for them; this means that higher resolutions might go unexploited even if Windows could operate in a CGA-compatible mode. Some of these boards are Hercules-compatible and would probably work.

I suspect that Microsoft will offer more options by the time the product arrives in the retail channel. I also expect that the manufacturers of other boards will provide their customers with a Windows device driver; such drivers can be added to the Windows master disk and can then be automatically activated by the Windows installation process.

As for disk storage, floppies do not support Windows very well. A hard disk or larger RAM disk is very important to give Windows the peppy performance that makes using the mouse pointing system effective. On a RAM disk, the Windows program and other commonly used programs should be stored there, although it should also be possible to load programs into the Windows environment, remove the floppy from whence they came, and let the system swap programs from memory to RAM disk as required. Programs that are overlaid (i.e., have other files that the program loads or uses as required during the course of execution) must be present on accessible media while executing.

You might be surprised that I mention a mouse as optional. Frankly, Win-



dows is better (most of the time) with a mouse than without. The human interface from the keyboard is excellent, though—far better than that of TopView. There are, however, times when I resort to the keyboard for some manipulations because they are quicker. Study of a small section of the manual will result in keyboard proficiency, which is worth learning.

The only tedious part of the keyboard interface is making menu selections from the menu bar at the top of the screen. For a bar with three menu selections, there is no problem. But for a Windows program with eight or ten menus, using the TAB key to move to the eighth one becomes time-consuming. So I suggest a mouse anyway. One final point: the use of the mouse or keyboard can be transparent to the executing program. For example, Microsoft supplies a sample program called Reversi (known more popularly as Othello). The game can be played faster with the mouse, but quite well with the keyboard. According to Microsoft, the program is not aware of the physical method of pointing being used.

Microsoft provided me with drivers for their own mice, and for the Mouse Systems PC Mouse.

The Interface

Windows presents itself to the user in much the same way that a Macintosh does. In fact, most of the elements of Mac are in Windows, even when the visual image is not quite the same. There are three components of this interface: the menu bar, the icon area, and the working screen.

The top of the screen has the menu bar from which pull-down menus are obtained and selections made. This is the main way in which things happen: the user points to the function desired and it is performed. The menu is applications sensitive, and saying any more than that the menus pull down requires a specific application context. Some special areas above the menu bar provide shortcuts: you can quickly terminate the program, suspend it, resize the window, or make the active window assume the full screen.

At the bottom of the display is the icon area, which contains the icons for programs that do not have an active window. Such programs may be suspended (that is, not running) or active (the program continues to execute even though something else is going on in the active window). When more than one program runs at the same time, the system is said to be concurrent.

Windows provides concurrency for programs written to be Windows-compliant, but cannot control execution of programs that do not obey the multitasking rules. Windows can also run more than one copy of a program at the same time regardless of compliance with the rules and as long as the program could have done that anyway.

A word of explanation on that is needed. Some programs make temporary "scratch" files. If the program always uses the same name for the scratch files, then two programs running at the same time will collide. *WordPerfect*, the word processing program I use, has precisely this problem. Many other programs are sure to as well. However, the good news is that a simple program change is all that is required to fix the problem.

Microsoft provides a program called Clock which displays an analog clock on the screen. Concurrency can be quickly demonstrated by starting more than one clock and giving each one a window on the screen. Each clock runs, meaning that Windows is switching control back and forth within the program.

You can point to one of the icons to activate a window in which to view the action of its program. The window is "opened" in the large working area of the screen between the menu bar and the icon area. More than one window may be active at a time, and Microsoft has chosen to "tile" its windows. That means that the windows do not overlap one another, but instead butt against one another. It is my opinion that this is a small point. However, it should be noted that overlapping windows allow you to size each window as appropriate for your applications, while tiling tends to force you to have the primary window sized properly, thus limiting other windows to the *remaining* space on the screen. Practically speaking, I think users are unlikely to have multiple windows showing as a general rule and are much more likely to switch from application to application on a full-screen basis. Getting an application from its icon to the full screen is quite fast and, therefore, practical.

Windows includes a program called the Control panel which can be used to set various system parameters. One control area is the color selections for the display. You can select a display color (on the CGA, various shades of black and white) for each component of the screen. This works very nicely on the EGA; careful selection of color truly enhances the presentation. One example: I changed the color of text from black to blue, which I find easier to look at on a white background. These kinds of changes can be made at any time, are permanent, and take immediate effect.

Overall Performance

I have mentioned several times that Windows seems to perform very well. The point should be clearly made: overall, Windows is a better performer than either TopView or GEM. It is *not*, however, a better performer than DOS, and that requires a little explanation.

First, programs will not run faster under Windows. They will run at about the same speed as they do without Windows, which is something of an accomplishment. In an environment that supports multi-tasking, some CPU resources must be given up to manage the system. Windows seems to have given up very little, and that is good. It is possible that *throughput* for a particular program will fall if other programs are running concurrently, but that is to be expected.

Second, Windows gets programs running faster than GEM or TopView—at least by my measurements. But, DOS is faster. There is obviously some overhead within Windows that is not present

when a command is typed to DOS. Windows does look for more information than DOS; for example, it hopes to find a program information file (PIF) that describes the operational parameters for the program. In fact, a PIF *must* be available for programs which expect to run concurrently or which are fully Windows-compliant. If no PIF is found, Windows assumes the worst case: a program that writes directly to the screen and from which Windows cannot be accessed.

Once in the MS-DOS Executive section of Windows, many operations are faster than their DOS counterparts. My favorites are COPY and DELETE, both of which work with multiple files. From the list of files on the screen, a set can be marked and all will be deleted or copied. Attempts to copy a directory work, in that the directory *and its contents* are copied, a sorely-needed improvement over other systems. The speed improvement here comes from avoidance of typing multiple commands in DOS, not from speedier execution of the code itself.

MS-DOS Executive

A place Windows excels is the MS-DOS Executive. In this window, the system displays icons for each disk drive, the name and volume label of the currently selected disk, the current path, and the names of all files and subdirectories in the current directory. Navigating around the directory structure on a hard disk, by which I mean changing from one to another, is very quick when the mouse is used, and Microsoft has introduced a number of clever shortcuts. For example, clicking on a part of the displayed path (for example, UTIL in \UTIL\COMM\XTALK) will cause an immediate change to that directory. Double-clicking on the names of one of the subdirectories, which are always listed first, causes a switch to that directory. Double-clicking on a .BAT, .COM, or .EXE file causes it to execute.

Another clever innovation is that the program can be instructed about filename extensions and told to execute a certain program when a file having such an extension is clicked. I call my working manuscripts .MAN; a click there invokes *WordPerfect*. Neat, and quite fast. I've told Windows about quite a few programs, and it saves a lot of time. By the way, that feature requires modifications to a text file named WIN.INI, the initialization file for Windows. I mention this because it is not immediately obvious from the documentation. Make edits carefully: this file contains many other initialization parameters, including things set from the control panel.

Overall Impressions

There is far too little space here to give a full review or examination of a product that will surely command much press attention in coming months. I like Windows and want to use it—a statement I could not make about the major competitors even though I have spent much time with each. But how good is Windows as a user interface? That's a hard question to answer.

How about this question: does Will Fastie use Windows? Answer: Yes. But I don't yet start it automatically—I'm still a bit tied to the command line interface. Time will tell. ■

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